Experimental Researches, Vol. 5, Cat. 997

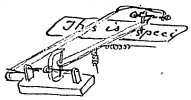
This notebook is divided into two parts. Pages 1-47 cover the period October 1875-January 1877 and deal with autographic and octruplex (acoustic) telegraphy, batteries and battery fluids, duplicating ink, applications for small electric motors, the electric pen and duplicating press, the mirror galvanometer, and the electromotograph. The descriptions are well illustrated, with detailed drawings of component parts and circuit diagrams. They are frequently signed and dated by Edison, Charles Batchelor, and James Adams. There are also several pages containing notes on new ideas relating to inventions such as an artificial fragrant rose, a pocket spectroscope, a flying bird, and an electric shear.

Pages 48-134 contain a series of illustrated caveats relating to various aspects of electric lighting and covering the period September 1878-December 1879. Many are signed by Edison. There is also one caveat for the telephone, dated 1879. On pages 171-173 is an undated, unsigned caveat or patent specification relating to telephone communications. The volume contains 640 numbered pages.

Blank pages not filmed: 136-169, 174-640.

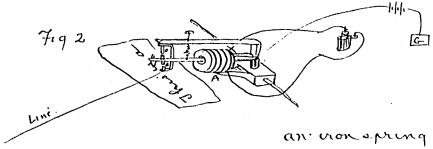
Autographic Telegraph

Fig. 1.



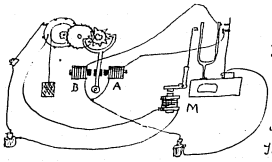
ink marks acting to increase friction moves a lever like the Electromotorgraph and opens an closes an electrical circuit.

Fig 2



an iron spring or lever b passing through a magnet or bobbin of wire, with battery attached, kept constantly magnetized, a gummy ink over which is sprinkled fine iron filings. The point on d comes very near the writing when it passes over a mark the iron filings act as an armature and attract it closing the line on the point d.

Fig. 3.



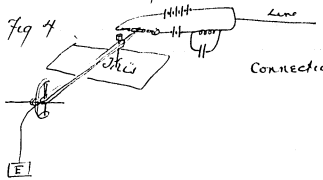
Tuning fork sending currents through A & B vibrating escapement with great regularity. Tuning fork kept in motion by separate magnet kept in motion at intervals by a break on last wheel of clockwork. Machines at both ends having forks vibrating same notes.

October 16th 1875.

Thos A. Edison
Chas Batchelor

Autographic Telegraph

Fig 4



Connections for transmitting

Instead of the ink acting as friction to move the lever and open and close the circuit the punctures made by the autographic press pen may be used the point catching in the holes carries the lever from point to point

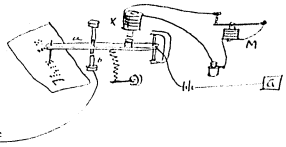
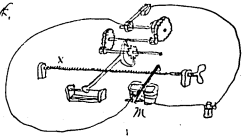


Fig 5

a is a lever vibrated with immense rapidity by the magnet X which is in a circuit with the self vibrating magnet M. or any rapid self Circuit breaker upon the end of a is a fine point which if there are no holes under it does not allow the lever a to touch the point b but when a hole occurs it enters it and allows the lever to touch b and close the circuit

Fig 6.



X. fig 6 is a pianoforte string making the smallest number of vibrations, in vibrating it works an escapement lever and release a tooth of the escapewheel attach movement allowing the Clockwork to move along with good speed and synchronous

with another machine with a like chord at the distant end The magnet M serves to give a constant vibration to X. it receives its breaks from a wheel & point on the slower moving wheels of the clockwork

Thos A Edison

October 16th 1875.

Chas Batchelor

Battery Fluids.

Try $KOCrO_3$ and $Ca-NO_3$.

Try $KOWO_3$.

Try KNO_3 5 parts SO_3 15 parts HO, 20 parts ✓

This gives NO_3. & $KOSO_3$ with probably less polarization than any fluid, especially $KOCrO_3$

Try ~~$KOCrO_3$~~ $HKCO_3$ 5 parts, (Bicarbonate KO) SO_3 15 parts HO 20 parts, Carb gas probably escape.

Try $KOCrO_3$ 5 parts NO_3 15 parts HO 20 parts

Try $KOCrO_3$ 5 parts NO_3 5 parts SO_3 15 parts HO 20 pts

Find a CrO_3 combined with an easily decomposed base for instance a soluble $FeCrO_3$ or other heavy metal.

Try NaCl 5 parts SO_3 15 parts makes chlorine Water The Electrolyte H will probably form with it HCl Immerse a platina plate in the porous pot of a battery connecting the same to the carbon and see if it has a tendency to depolarize,

Try some Muriate Calcium (bleaching powder) + in porous cell. probably H combines with loose atom Cl to form HCl.

Try Permanganate KO, 5 parts SO_3 15 parts HO 20 do makes manganese heptoxide. Mn_2O_7

Try $KOCrO_3$ 5 pts SO_3 15 pts NaCl. 5 pts HO 10 parts

Try Black Ox Mn 5 pts SO_3 15 pts NO 20 pts

Get some perchlorate of Potash!

Fuse Chlorate K until it boils and just as it solidifies stop take 4 parts add SO_3 16 parts then dilute makes perchloric acid one most powerful oxidizer known. use it in porous cell

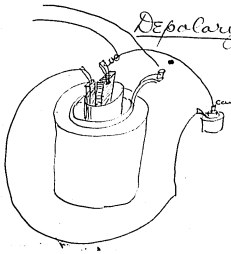
Use the 1½ batteries well cleaned for

These experiments became all bad resultants and
October 16th 1875

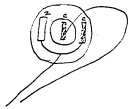
Thos A. Edison
Chas Batchelor

James Adams

Depolarization of Batteries



small depolarizing battery.



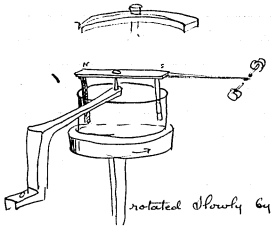
October 16th 1875

Thos A. Edison
James Adams

Battery Fluids

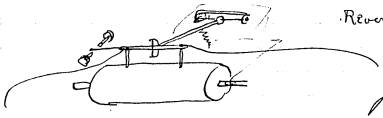
Try $KOCrO_3$ 5 parts SO_3 15 parts HO. "5" parts
Try $KOCrO_3$ 5 parts SO_3 20 parts no HO.
Try $KOCrO_3$ 10 parts SO_3 10 parts "
Try NO_5 alone —

Delicate Electromotograph

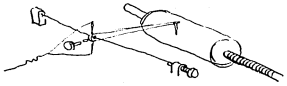


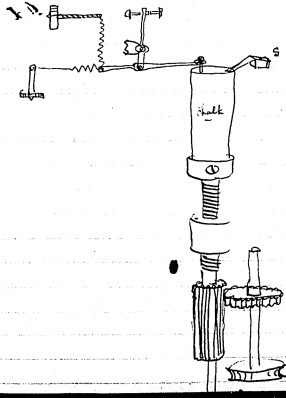
rotated slowly by an Electric Engine.

Aug 25 1876.
T. A. Edison
Chas Batchelor



Reverse Current EMQ
Aug 25 1876
T. A. Edison
James Adams





EMQ principle
S is a scraper which
cuts off the chalk off
Even as it rises —
this gives the second
point from a clean
fresh surface —

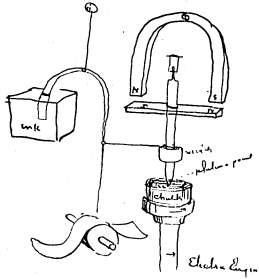
Aug 25 1876
T. A. Edison
James Adams

Electric Eng

Scheme for Autographic Printing.

Write on a sheet of paper with strong solution of Bichromate of potash, then have dry gelatine Coated sheet, slightly moisten these, then lay on Bichromated writing sheet press. This will transfer writing to gelatine sheet. Expose to light the will render part where Bichromate writing is insoluble, then Either wash & print by pressure of paper or by photo lithographic style.

August 28 1876 - T. A. Edison

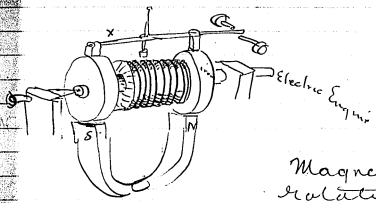


Lady Sporter Mutograph

Aug 28 1876
T. A. Edison
Chas Batchelor
James Adams

I found that if a glass tube is mounted on a bottle containing H_2S gas & the point of the tube drawn out very fine that H_2S passes all right but by holding paper wet with a solution of Plumbic Acetate point of the orifice the mark so obtained is to broad it spreads 1/16 even with very narrow orifice; tried holding little piece of Sulphuret of potash near lead paper but it dont give off enough gas; the pencil was rather old,

Aug 28 1876. T. A. Edison



Magnet Constantly Polarized =

placing the large permanent magnet where it is, is a mistake. The working bridge X should be polarized so that both ends should have the same polarity. This arrangement is a partial application of the EMF principle to a polarized relay. Aug 28 1876
T. A. Edison

I have an idea that an artificial rose could be made of such an nature that it would remain stiff and at the same time absorb by capillary attraction atto of Rose perfume from a bottle which is filled with it & which acts as the holder in the button hole;

Aug 28 1876 T. A. Edison

I have an idea that a cheap 25c pocket Spectroscope would sell on the street. The tube being cast in lead or tin, Canada Balsam used as a magnifier & common chandelier prisms broken in short pieces used for prisms.

Aug 28 1876 T. A. Edison
Chas Batchelor

I have an idea that the Electric pen could be attached to a stiff brass pantagraph and by such drawings made with it =

Aug 28 1876,
James Adams

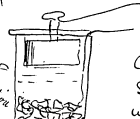
I have an idea that perforated stencil sheets similar to those produced by the electric pen only done by a stamping machine with larger holes representing outline stationary, landscapes etc could be sold in large quantities to Druggists etc to ornament mirrors windows etc by marking through the stencil with French Chalk; etc,

Aug 28 1876 – In addition book accompanied with Colors etc could be made wholly with a number of stencils any kind of a picture could be produced, & these books sold to the trade to be used for Educational purposes & for amusement,

Aug 28 1876. T A Edison. Spoke of this one 8 mos ago.

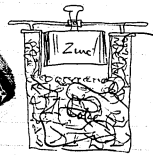
Battery.

Edison's Patent No 4 for reduction of Copper



I used coke which is a fair Conductor & very porous and string the pieces on a Copper wire so that the coke is Electrically Connected together and mixed in with the pieces are the crystals of Cupric Sulphate. The Coke soon becomes plated with Copper owing to it porosity gives an enormous surface

I propose another method thus: —

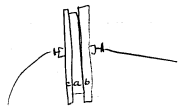


I use a porous tube open at both ends in which I place the Zinc hence I am enabled to place the Coke from bottom to top and near the zinc,

Another method is to place a disk of Copper at the bottom and fill in granulated Copper head,

Aug 28 1876 T A Edison

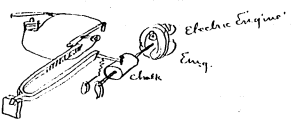
Powerful inexpensive Condensers



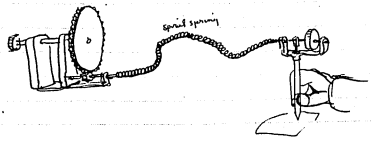
Aug 28 1876 =

T A Edison

a & b are platinized disks, a is a block of chalk or other porous substance saturated with polarizable chemicals such as Caustic Soda. (Edison.)

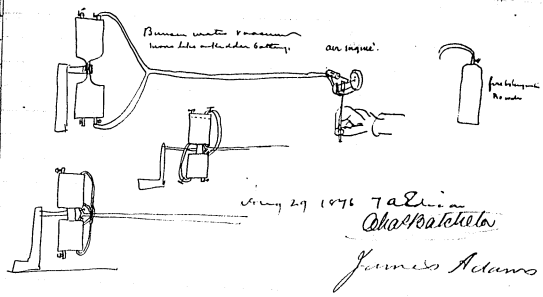


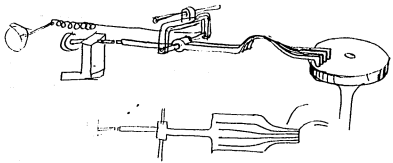
1st Acoustic Telegraph I propose to use a number of tuning forks upon the ends of which are lines resting up revolving Chalk cylinders maintained with a chemical solution, and so arranged that the Emery principle sets the fork in motion, one simple cylinder may be used to set several forks in motion, Aug 28 1876 T A Edison.

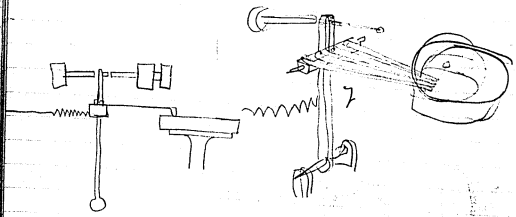


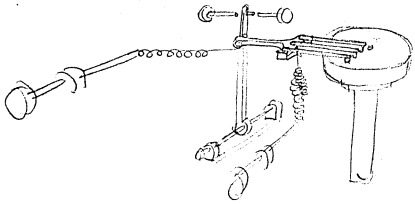
Method of working the perforating pen by flexible Spiral Spring

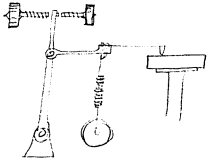
Aug 29 1876 Edison

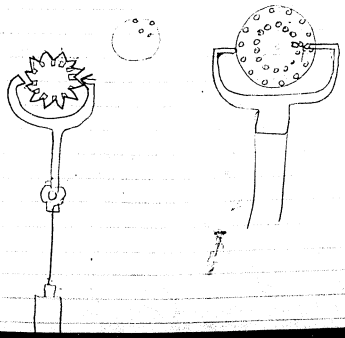

Bunsen water pressure
can inquire.
Chatkatchela
James Adams

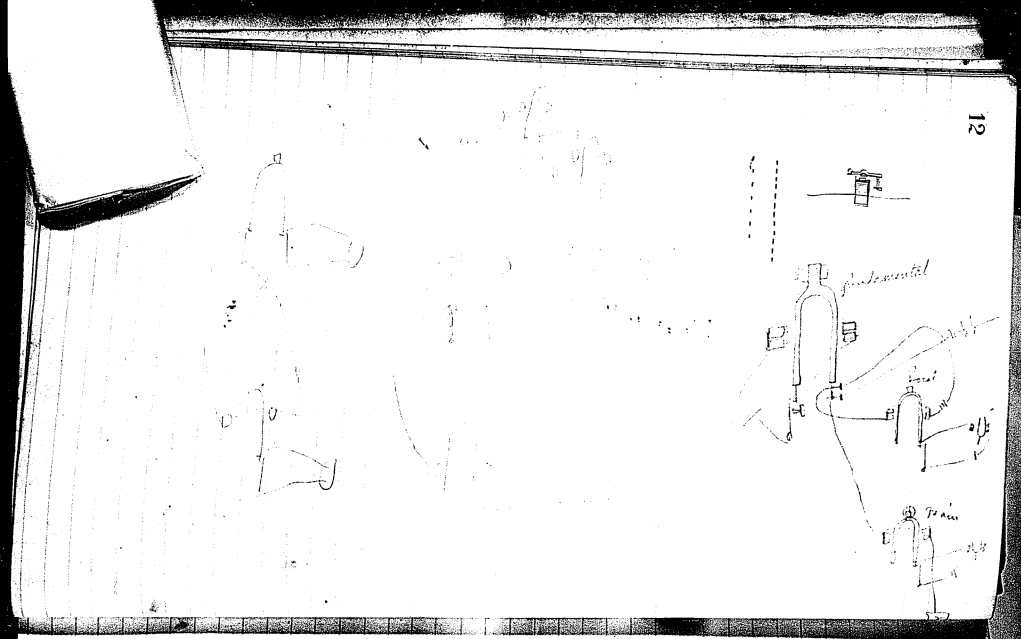






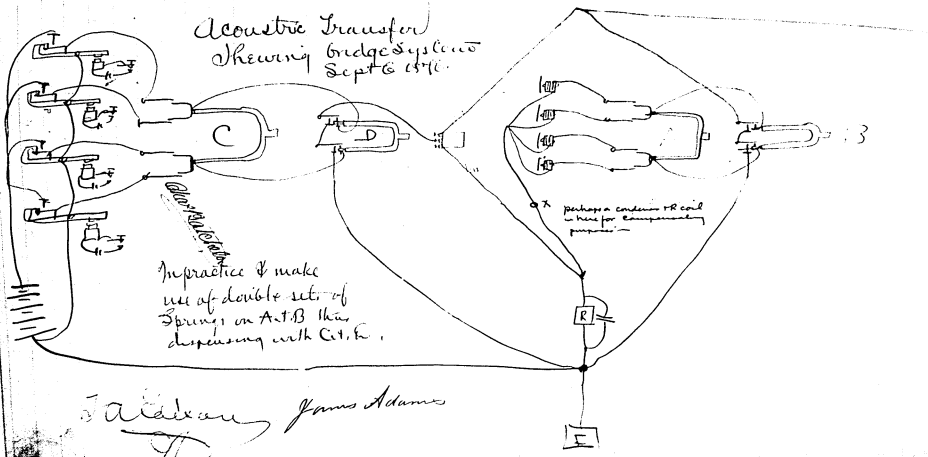






Octruplex

Acoustic Transfer
Showing bridge system
Sept 6 1876.



In practice I make
use of double set of
springs on A & B thus
dispensing with C & D.

Alexander Graham Bell

James Adams

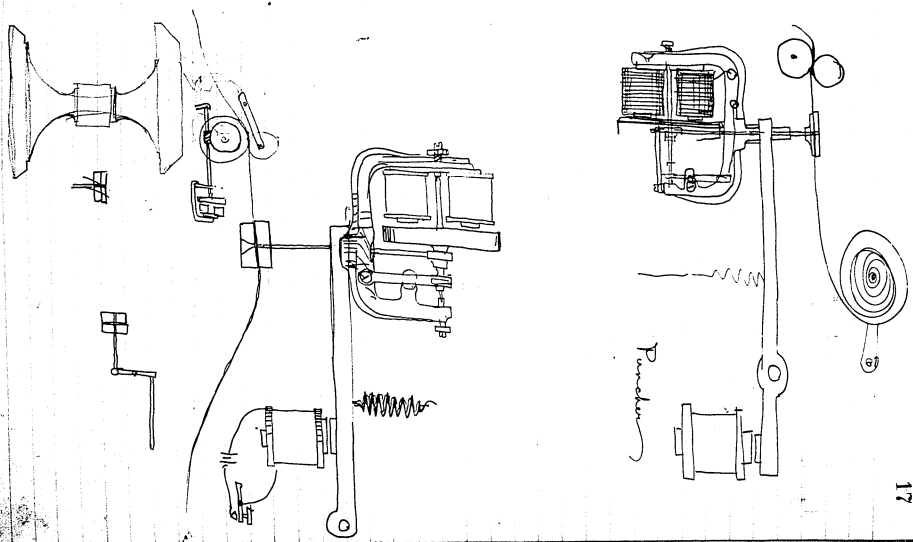
E
E
E

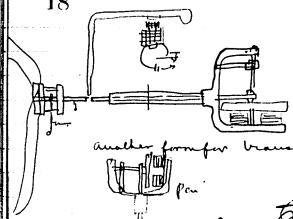
Electroplex
Cutoff principle
with Bridge System
E
James A. Adams
Sept 6 1896.
Witness
Witness

New system based on the Electromotograph. first. I propose to use Morse registers or other means such as a magnetic engine to move the strip of paper along and I arrange a single punch & mechanism on the lever of the register which is moved by a magnet in a local circuit operated by a key. The little punch is vibrated with immense rapidity in the same manner as the needle in the Electromotograph & the whole is so arranged that when a messenger is sent on the key the lever will bring the punching device in play & punch holes in the paper instead of embossing the characters as when the registers are used in the ordinary manner. The punched strip is then taken to the transmitter which consists of a pelton wheel drum rotated by suitable machinery & the paper passed rapidly through it & the contact roller serves to open & close the circuit & transmit the characters to the distant station.

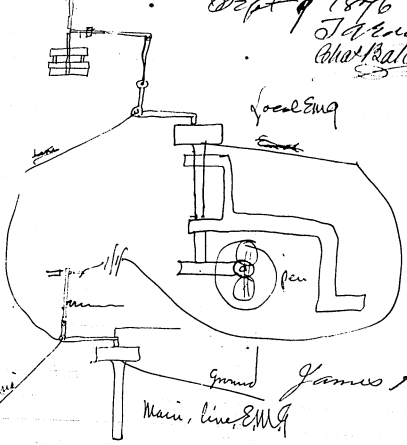
The transmitter consists of the lever of the Electromotograph, which corresponds to several hundred words per minute. This lever opens & closes the circuit of a local battery & local Electromotograph whose lever moves with great force. This second lever serves to bring into play a perforating tool similar to that employed in preparing the transmitting strip. The reproducer the messenger on a strip perforated, the strip is then passed between a point & drum rotated slowly and connected to a sounder & the operator copies the message by sound.

J. A. Brown Sept 4 1876





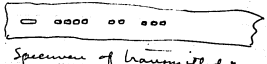
another form for transmitter pumicher



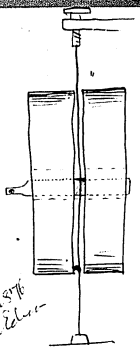
Sept 9 1876
T A Edison
Chas Batchelor

local EMG

James Adams

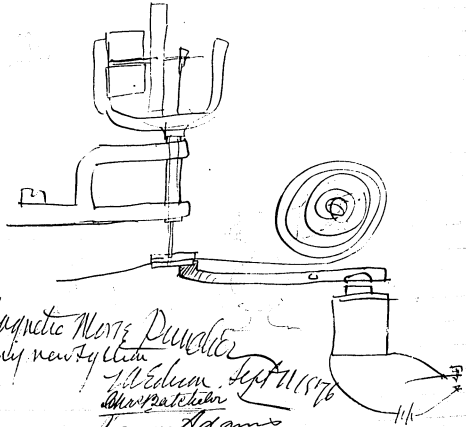


Specimen of transmitted & reproduced perforation

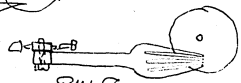


Sept 15 1876
T A Edison

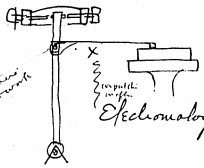
Memory alexanometer spools with thin sheet steel needle having great deflection force and adjusted by forming another extreme end in a platinum plate or point playing ~~[illegible]~~ in between contact points. & by putting a condenser in line, and sending reversed currents the reversing reversers currents are substituted to work the needle tongue with great rapidity and thus enabling me to separate my signal signals from mere automatic current into another



Magnetic Morse Duplex
formly neutral system
T A Edison Sept 11 1876
Chas Batchelor
James Adams



EMG



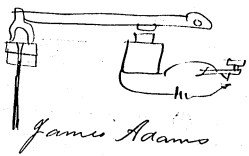
New style lever we are putting on today.

Sept 11 1876

TAE

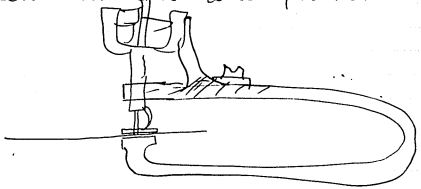
Solution for EMG
Pyrogallic Acid & Acid
Caustic Soda
Caustic Soda & Gum Gamboge
Caustic Soda & Acetate Mercury
Other Caustic Alkalis & Acetate Mercury.
Ferrocyanide Ferricyanide & Acetate Lead
Caustic Alkali & Balsam Copaiba,

Sept 11 1876 T A Edison



James Adams

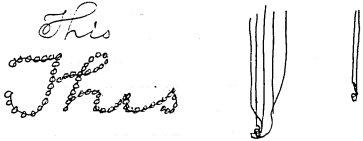
I propose to use a panlagraph movement for preparing messages for Autographic transmission in this manner — I secure to one prong to a panlagraph an Electric pen with die arrangd thus



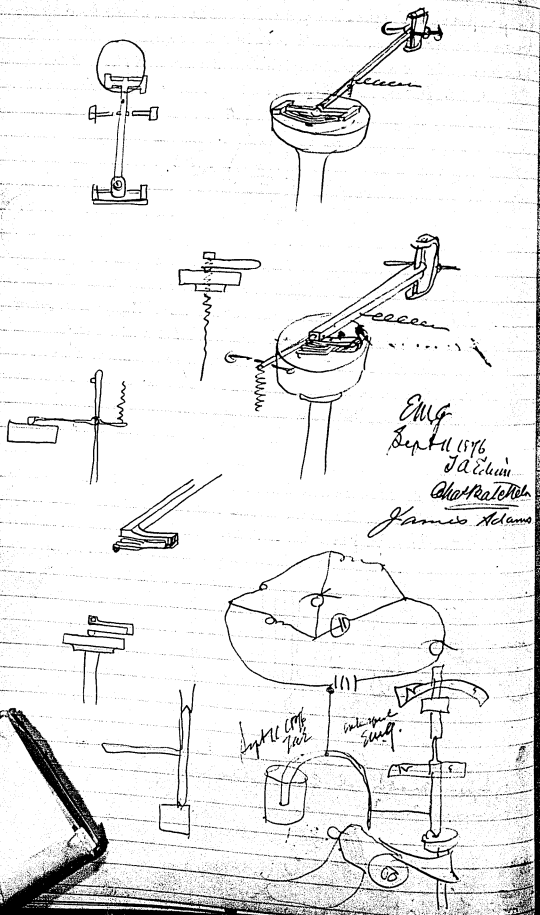
so that when a person writes with the lines cutting the pencil the pen & die with move with it and produce the Copy enlarged 3 or 4 times in perforations which can then be transmitted with Ease.

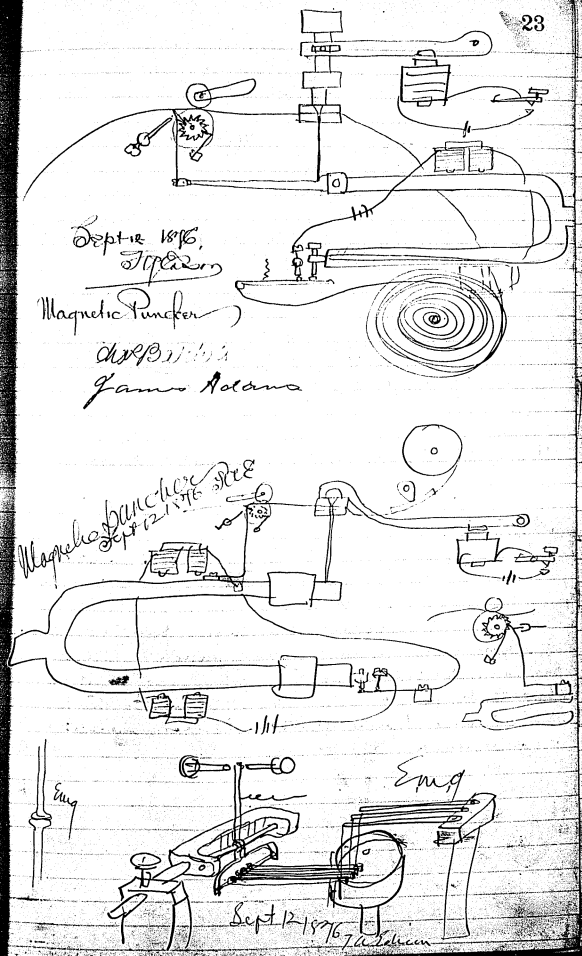
Sept 11 1876 T A Edison

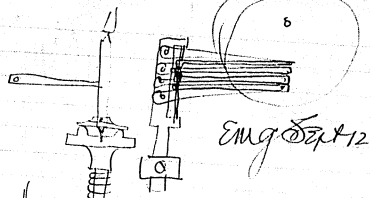
Another method is to make the end of the needle of an electric pen larger & punch like a cutting punch thus James Adams

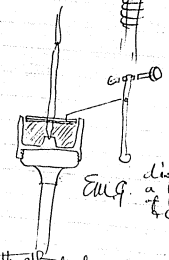


by using very thin paper & laying it on thick paper material the holes could be easily punched —


Emg
Sept 11 1876
T A Edison
Chas Batchelor
James Adams
Sept 11 1876
T A E
Emg.


Sept 12 1876.
T A Edison
Magnetic Puncher
James Adams
Emg
Sept 12 1876 T A Edison

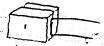




We now place a pad of Soft Bolting cloth on the disk of the EMG Cover it with Dick & wet. This is the best yet found =

Worth Paul today in making a Compact Magnetic puncher.

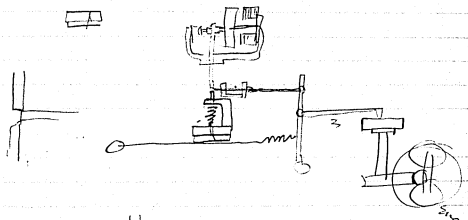
Sept 15th 1876

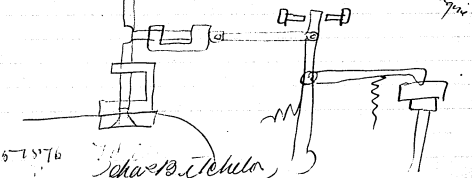


die for magnetic Engine puncher

I propose using instead of a round punch a square Edge punch in this shape actual size ~~M G~~ about 1/32 high & ▯ about 1/16 thick this will make square holes & dashes because it requires much less power.

I shall use if possible the main line EMG to set in motion direct the repuncher thus

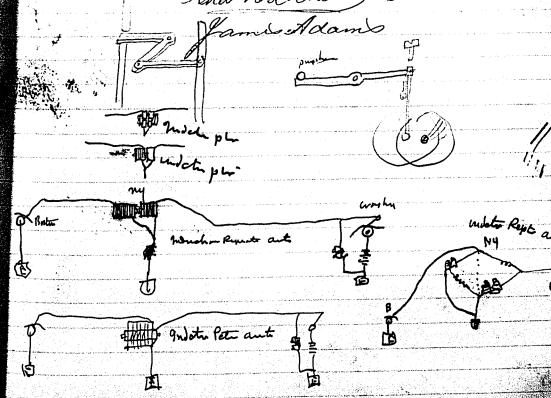


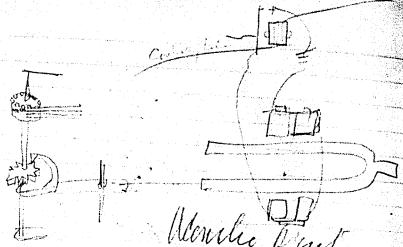


Sept 15th 1876

Chas B Nichols

Frank Adams





Electric Fuse

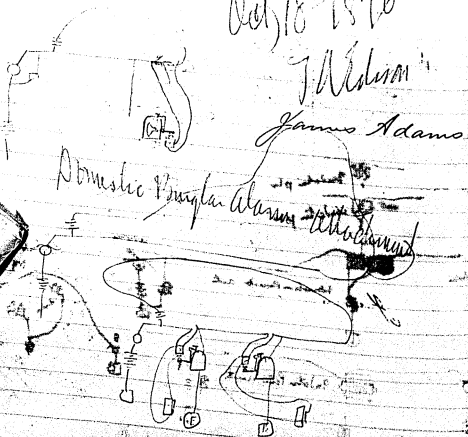
Oct 10 1876

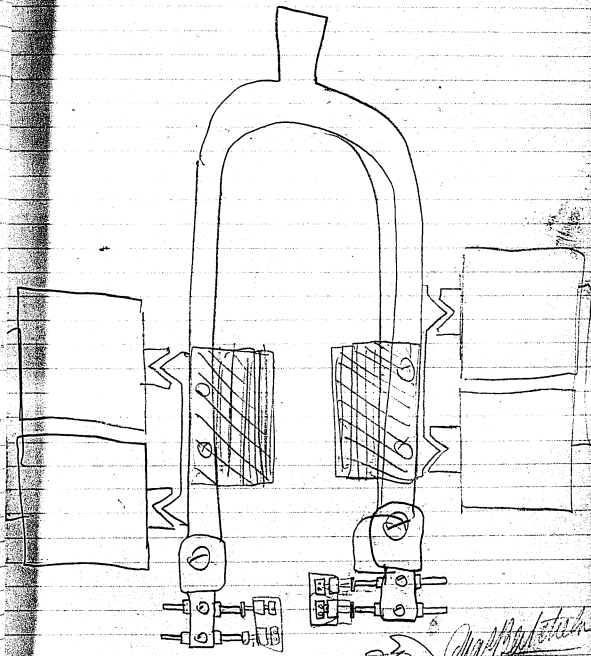
J. Adams

James Adams

Domestic Burglar Alarm

Attachment





James Adams

Witnesses
Chas. Ashton
Geo. Ashton

Inventor
James Adams

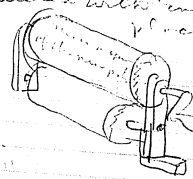
Frame
Working Contacts closed
Frame
Chas Batchelor

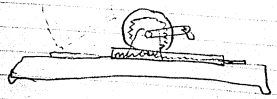
Chas Batchelor
Frame Adams
Electric Sewing Machine
Sewing foot applied
to drive machine which
feeds extra motion by
electromagnets
Oct 16 1896
Wm Mills
Wooden wheel Guards
Frame of sheet iron
Brass Bearings
Cast iron Frame
Wooden wheel Guards
Wm Mills

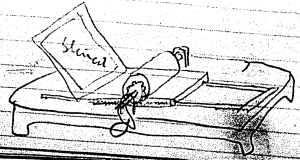
If the switching forks are worked direct on the Cutting lever, duplex, it will probably be necessary to add a Condenser shunting a Rheostat or bridge wire to weaken the Effect of the Sliding Change otherwise one fork will hug on the other & change the currents =

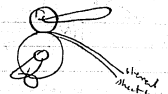
Idea has occurred to me to arrange two needles with Elastic eye one having an eye at the end with a thread the other pointed with a hook so that by passing pin over Cloth stretched it will make a loop which then allowing beautiful Embroidery etc to be made at high speed =

Sketch Copying Process felt Roll saturated with ink over which sheet is passed pressure by heavy roll cranked in = The rollers are geared or otherwise fastened together & paper is passed between them





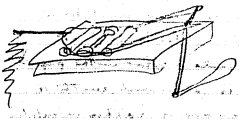


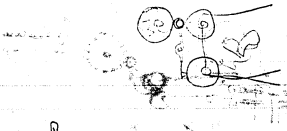


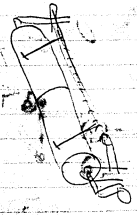
Oct 18 1876.

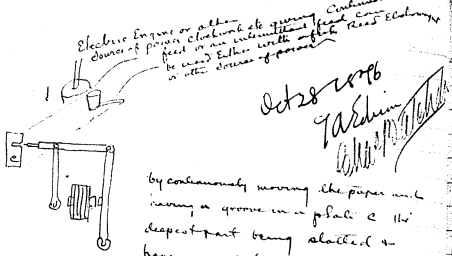
Chas Batchelor

James Adams



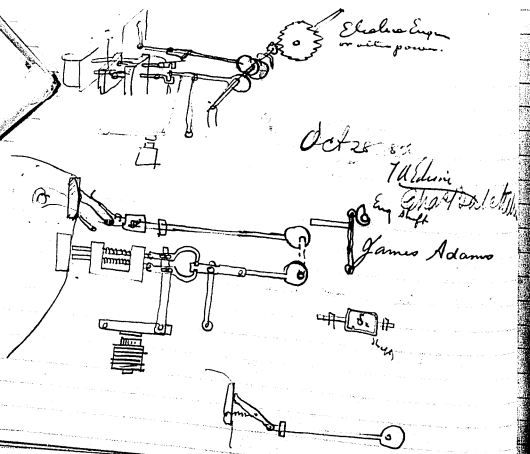




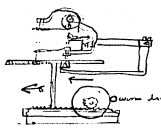


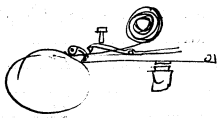
by continuously moving the paper and having a groove in a plate c the deepest part being slanted & having an embossing point have a knife on it & a cam and it

Emboss & at the same time cuts a slot with paper in horizontally the central lever is provided with a Knife Edge point and the Emboss or rather indentation as I prefer to use the ~~make~~ latter guides the point & it by pressure drops into the indentation & through the slot allowing its end to touch a contact point thus closing the circuit



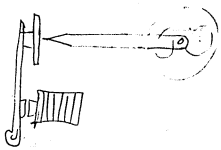
I propose to arrange the punching and feeding devices in such a manner that I can punch the messages on a Continuous Circuit like the record of a Bain chemical disk. Starting the message 2 inches from the centre & thence outward I can use a square blank & this will be very convenient for handling. The disk may be revolved by one of the Eccentrics on the motor feeding it around step by step, and the other carrying the disk secured to a movable slide is moved continuously by another motor.





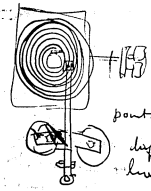
idea is to have rolls of tin foil, 1/8 strips wide. and form characters by forcing it down on pasted paper by magnet

~~Stroke~~ Keeping clamp allows foil to run out from roll & pasted to roll but when lever raises brush foil & again allows it to run out when closed again =



Oct. 26 1876 T. A. Edison

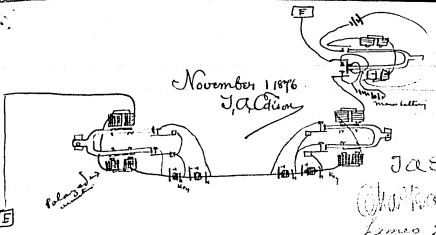
— ·· — ·· — Electric pen large needle dots + dashes formed. Moment of hand full thickness paper clear sounder + chemical fluid of the dots which turn + open circuit + Rem points.



Embossing

dog plate for feeding the pointed lines out

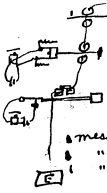
James Adams



November 1 1876
T. A. Edison

JAE

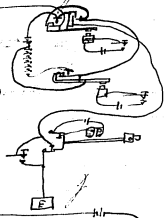
James Adams

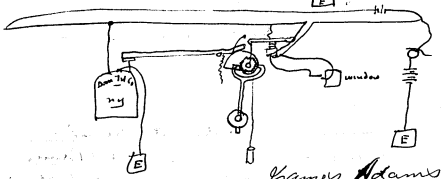


November 1 1876
T. A. Edison

you can Duplex. Sp's.
make .6.

message by reversals
" by increase + decrease
" by acoustic vibrations

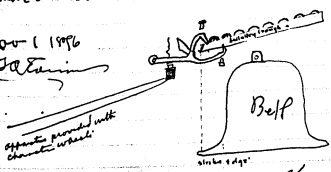




James Adams

~~with~~ burglar alarm circuit closers on windows of a house ~~control~~ short circuits magnet + chest release button pushing mechanism which is so arranged that the cord is just long enough to depress button 4 times more or less.

Nov 1 1876
T. A. Edison



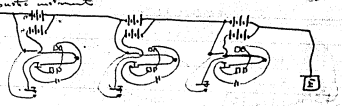
opposite pointed with chemical which

Tower Bell strikes for fire or Telegr.
Common bells released at proper instant by a magnet

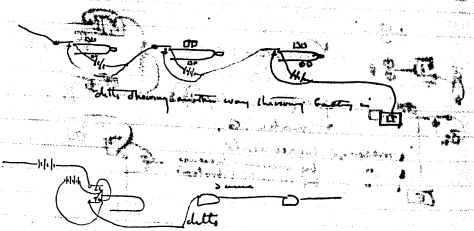
James Adams

Nov 1 1876 T A Edison

to distant acoustic instrument

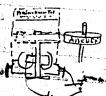


acoustic transmitters, each making different note



Throws in a multiplying battery to right multiplyer to left Double strength = [illegible]

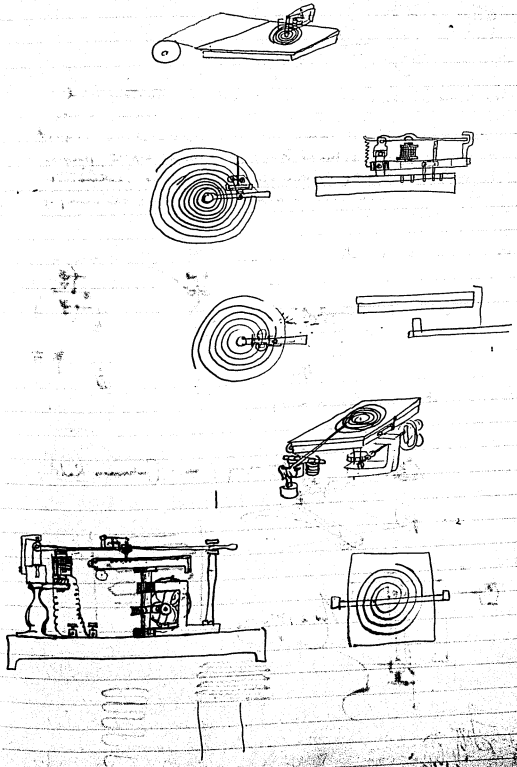
Nov 1 1876 T A Edison



Continuous Printer. Method of putting strips on WU Blanks

Everytime you print letter it [illegible] parts on strip you can see [illegible] have to punch [illegible]

I propose now to emboss the messages for transmission by having the blank stationary on a revolving spiral block the blank being held down by another block with revolving spiral grooves cut clear through



Perforating

Emy. Internal interrupter cut of Emmy = perforator

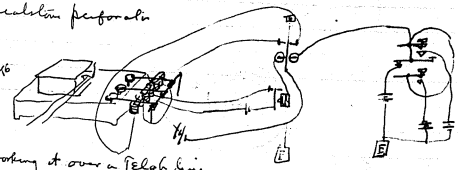
Nov 2 1876
T A Edison

James Adams

Reference

doubled up platina wire kept white hot by a battery and connected to a magnet operated by a Relay or key or direct on a Telegh line. The closing of the magnet serves to bring White hot platina up to paper & burns it, which the length of which is determined by the continuous moved paper, & length of closing of the magnet =

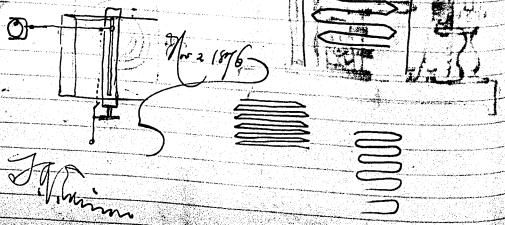
Wheatstone perforator



Nov 22 1876

for working it over a Telegh line.

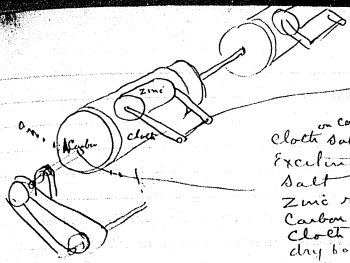
Embossing from Gutenberg Roll—



Nov 2 1876

T A Edison

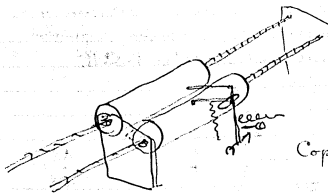
Galvanic battery



on Carbon Roll.
Cloth saturated with Exciting Solution & a Salt Hg. rotated.
Zinc roller & or vice versa, Carbon roller + zinc with Cloth on = object semi dry battery - no polarization

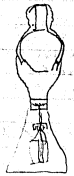
Nov. 6. 1876, T. A. Edison

James Adams



Copying machine.

I propose to write the letter etc with an ink that will give great frictional surface; place it on a drum provided with an EMG lever, on the extreme end of which is a fountain pen opposite another roller with the paper on for receiving the copy the ink marks by their friction move the EMG lever. Cause it to bring the fountain pen against the other paper at every mark the Cylinder revolves by gear & are fed endwise by any or both devices such as a ratchet, worm - screw, the whole thing may be rotated by pen electric engine, Clockwork hand power foot, or any source of power or a tuning fork, or an Motion by magnet = I can use a stylus, & put carbonized paper over recorded paper & receive the copy on the ordinary EMG lines. This is Expeditious Copying — Nov 6 1876 T A Edison

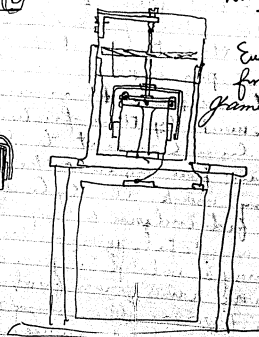


Lamps

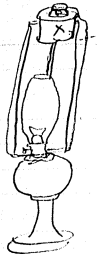
I propose to replace the clockwork fan blowers of Kerosene lamps that work without a Chimney by an Electric Engine for the purpose of working a fan, which engine is to be run by a Cell of Battery inside the base of the lamp: for this purpose I prefer to use a sealed Leclanche Cell.

Nov 15 1878
T A Edison

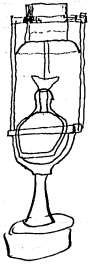
Nov 15
1878 T A Edison

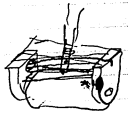


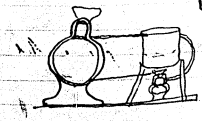
Engine Blower
for Lamp
James Adams

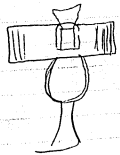


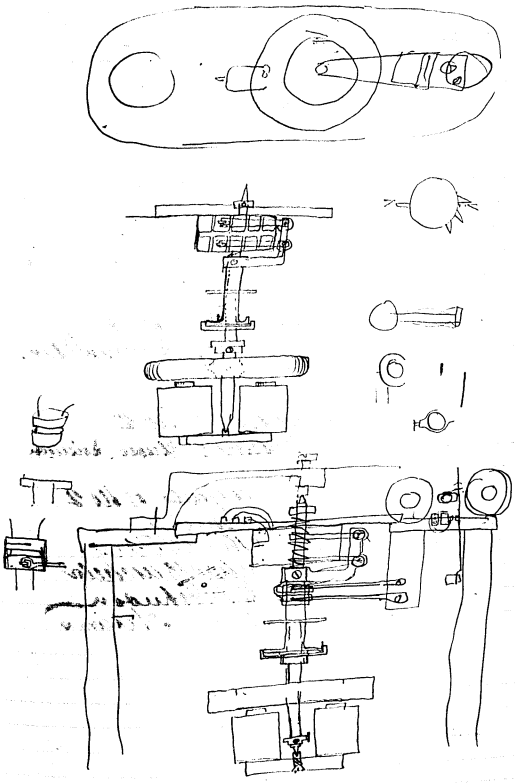
I utilize the heat of the lamp to set free oxygen gas from the Chlorate K + MnO3 in the Metal box X, the gas is conducted to the burner by means of the tripod of tubes & it is natural enough that the chimney is used as the source of O x that will take care of the Carbon & there will be quite a draft.











Edison's Duplicating Ink

On the 1st day of December 1876 or thereabouts Edison compounded the following ingredients to form a new copying ink:- Aniline Violet, Alcohol and Gum dextrine in the proportions as mentioned below. We find it superior to anything in the market it being able to do the following:- A copy can be taken on letter press paper & from such copy numerous copies can be taken on letter or other paper. A copy can be taken from such copy at any future time - The following are the proportions to manufacture this ink:-

2 galls & 1 pint of Alcohol
5 lb 5 oz of Aniline Violet
4 Galls & 1½ pint of Water } No 1 Solution (Stain).

20 ¼ Galls Hot water
21½ lbs of Gum dextrine } No 2 (Stain. Solution)

1 Gall of No 1 to 4 Galls of No 2 and stir well before bottling

Dec 13th 1876

Thos A Edison
Charles Batchelor
E. N. Johnson
James Adams

Proposed application of small electric Engines, some of which I have already experimented with, and am now engaged in experimenting with.

Flying Bird, composed of hollow core iron magnet, paper wings and self vibrating break, with a homeopathic vial attached containing zinc highly amalgamated & carbon - using strong bichromate of potash, the idea being that it will fly a 1000 or more feet high & a considerable distance, according to the strength of the battery & its lasting qualities. Object. a pleasing scientific toy & perhaps it might be used for carrying communications short distances with proper windless &c.

Electric Shears for cutting cloth, paper, tin foil etc consists of a rapidly revolving sharp edged disk against & a little below a straight edged presser foot.

An electric Engine, portable like Electric Pen with vertical revolving shaft holding a diamond pointed tool - it may vibrate up & down like the pen & the diamond cut the Shield Blank - for Engraving on glass

An Electric pen on a pantagraph - also the Engraving Electric Engine.

A portable Electric Engine with double needle one showing thread through cloth & the other passing through & hooking it pulling up a loop for Embroidery

An Electric Engine with worm & worm wheel for revolving the Lenses of a Calcium light Also for Revolving show goods in Windows Also for Working Morse Registers

Ideas

Dental plugger –

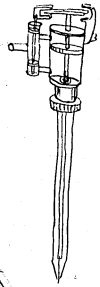
Make a ribbon of glycerine & aniline for elephant for type writer for duplicating.
Try Chl Zinc Dexter's Aniline which is poly basic

Get up a brick for carbon paper & soak the tissues of paper let the ink be the same

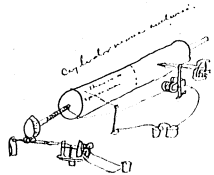
Electric Vibrator or Engraver to give a down forward & upward motion to a graver for Engraving

Gary Stamping

Adams



Pneumatic Pen

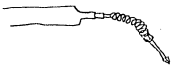


Jany 9 1877

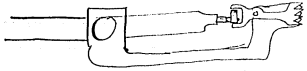
E. Engraver runs cylinder. Electric pen on one end control point at other – you work on cylinder or on lin. fact. & its "stencilled" by Electric pen –

Electric Engraver

fathers attachment to portable



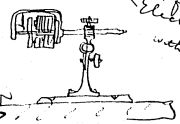
flexible tool & go adjustable of portable Electric Engraver



Horse Clipping attachment to Portable Electric Engraver –

Stand for portable Electric Engraver with background.

Jany 9 1876 =



H Edson
Edward Scholes

Menlo Park N.J. Sept 27. 1878

The remainder of this book will contain Caveats alone

Wm Carman

Caveat for Electric Light spirals

The object of this invention is to produce light for illuminating purposes by metals heated to incandescence, by the passage of an electric current through them, a great number of pieces of such metals forming part of an electric circuit, and distributed at various parts of the same

The invention consists in devices whereby the heat arising from the passage of such current is utilized to regulate the temperature of the incandescent metal which serves to give the light so that it is never allowed to reach its melting point, now matter how strong a current attempts to pass through.

Heretofore strips, thin wires of Platinum, Iridium and other metals have been included in the electric circuit and the passage of the current through them has brought them to a state of incandescence thus giving light but a careful regulation of the strength of the current is necessary otherwise the wire will either be melted or fall below a temperature necessary to give a good light.
My invention is adapted to overcome this constant watchfulness and causes each spiral to automatically regulate its own temperature. I shall describe many variations in the devices which I am now - which I propose to experiment with ——

Fig 1 is a magneto electric machine supplying currents to a circuit 2 — 2.
R.R.R. etc are resistances placed in the circuit at any point where a light is desired. the resistances allows of a portion of the current going

shunted through a metallic spiral wire sheet or other conductor which is to be made incandescent:
In figure 2. as shown on form of electric lamp
a is a platinum or iridium wire (it may be made of any metal or conductor having a high melting point or be made in a form of a wheel or solid spiral)
b is a rod preferably of zinc or other expansible material and this is secured firmly at B and passes through the centre of the spiral a. It connects at the other extremity with a lever 5 and serves to give a downward motion to the same when the rod 6 is expanded by the heat of the spiral on the end of the lever 5 is a platina point which in its normal position rests against the platina pointed screw 7 - H is the frame of the instrument and is of metal, the current passes through wire 1 to the rod (insulated) 2 thence down the spiral to the rod 5 and frame H thence to the screw 7 to wire 8 back to the resistance R. The resistance of the latter is such that it allows of a powerful current to pass within this derived circuit heating the spiral a to incandescence as the spiral approaches its melting point the rod 6 expands and carries the rod 5 away from the screw 7 and so no the circuit. the temperature of the spiral immediately falls as well as that of the rod. 6. when then contacts and causes the lever to again come in contact with the screw 7. and the spiral again approaches its melting point. the lever 5 which is springy or rather elastic is so adjusted in relation to the screw 7. that without so degrees of temperature of the melting point of the metal of the spiral a. the lever leaves the screw, hence as matter what amount of current is used the heat of the spiral acts upon devices to regulate its temperature and prevent ration hence an excess of current sufficient to fuse the spiral improvided with the regulator may be used necessarily.
In fig 3. as shown another modification in this case the connections and operation is the same

except that the expansion of the spiral itself is used to give motion of the lever 5.
In fig 4. The circuit is arranged in such a manner that when the lever 5 is thrown downward by the expansion of the rod. 6. It comes in contact with the point 7. and forms a second derived circuit thus weakening the current in the derivation containing the spiral and reducing its temperature
In figure 5 the operation is the same except the expansion of the spiral, itself gives motion to the lever 5.
In figure 6. a glass tube d passes through the centre of the spiral - a. through this tube passes the expanding rod 6. The operation is the same as in figure 4. but it is a more convenient device.
In fig 7 is shown the wire to be rendered incandescent coiled in the form of a volute spiral the inner end secured to a shaft. C the other end to a permanent fixture. m. the shaft has a lever J which approaches or recedes from a platina pointed screw H. when the temperature rises or falls. Its operation is the same as fig 5.
In figure 8 The expansion of the rod 6 and downward movement of the lever 5 places in the derivation containing the heated spiral a. an extra resistance R' which lowers its temperature by weakening the current —
In fig 9. a is the spiral. m two strips of metal fastened together a being steel and B zinc (any two substances one of which expands more than the other may be used) These are placed in close proximity to the spiral. in their normal condition B is in contact with the screw 6. and the spiral a is heated when it approaches its melting point the strips bend out and connection is broken between B & 6. the spiral cools and B comes again in contact with C and so on —

In figure 10 the operation is the same except that the circuit is not entirely broken a resistance R' being included in the circuit which is separate from C.
In figure 11 the expanding rod b. gives motion through a compound lever b a cooling bar B. which approaches and cools the spiral as the rod b expands.
In figure 12 a double strip. M. secured at X expands and approaches. and cools the spiral a as ~~just~~ its temperature rises.
In figure 13 an electro magnet. M. replaced to receive a current of little less strength than would melt the spiral is included in the shunt with it. hence when the current is increased from any cause to melt the spiral the circuit opens.
In fig 14. shows the same thing except the magnet is included in a permanent derivation
In figure 15. the magnet M instead of entirely opening the circuit throws a resistance R' into the circuit to weaken it.

In figure 16 a thermo electric pile X is placed in close proximity to the heated spiral the current from it activates a magnet M whose lever M and point O opens and closes the shunt containing the spiral a, when the temperature of the spiral becomes too high the current generated by the thermo pile. causes the magnet M to attract its lever and then the derivation of the spiral a. its temperature decreases the thermo current weakens and the lever M ~~comes~~ in contact with O and so on —
In fig 17. the lever G of the magnet closes up the spiral when the current increases.
Fig 18 shows the expansion rod b throwing in resistance R' R² R³ on its downward motion. thus weakening the current.

In figure 19. a sheet of platina or other substance is used for giving light by the passage of the current. hung to the bottom is the lever 5 carrying a large weight X on its extreme end. In its normal position the point on X is in contact with 7. but when a becomes too hot its expansion is sufficient to separate X from 7 and it immediately cools only to make contact and break the circuit again —
In fig 20 - a magnet. M. similar to an ordinary duplex transmitting sounder is included in the derivation when the lever is unattracted the spiral a is in circuit through the lever e and spring. C. when the current is increased from any cause the magnet lever is attracted throwing a out of circuit and bringing in a resistence R' (equal to a) in circuit. this device is not strictly a regulator but is only useful for experimenting where it is desirable to have some device to prevent destruction of the spiral
In figure 21. C is a button of finely divided conducting matter that varies its resistance by pressure. This button is placed between two metallic armatures a x B. - D is a lever which is pressed down upon the armature B by the spring E aided by the screw g. X is a rod of material quite expansible by heat this is secured permanently at the top and rests upon the lever D at the bottom. F is the platina spiral. The current passes from wires 1 to the armature a. through the button to 6 thence through the lever d to the spiral F out again. when the spiral is heated by the passage of the current the rod X expands and decreases the pressure of the lever d on the button. resistance is put in circuit by this lessened pressure and the temperature of the spiral decreased. hence by adjusting the rod X and spring e. the spiral may be brought to any required temperature,

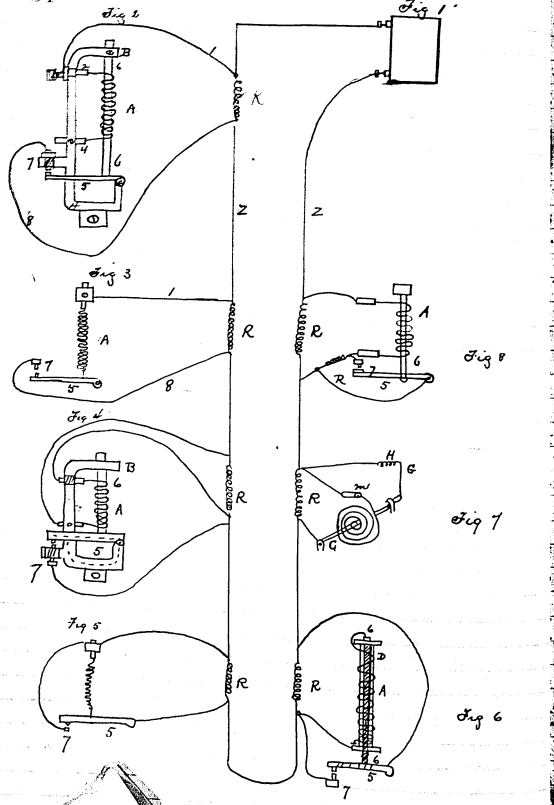


Fig 1
Fig 2
Fig 3
Fig 4
Fig 5
Fig 6
Fig 7
Fig 8
A
B
R
Z
K
H
G
M
1
4
5
6
7
8

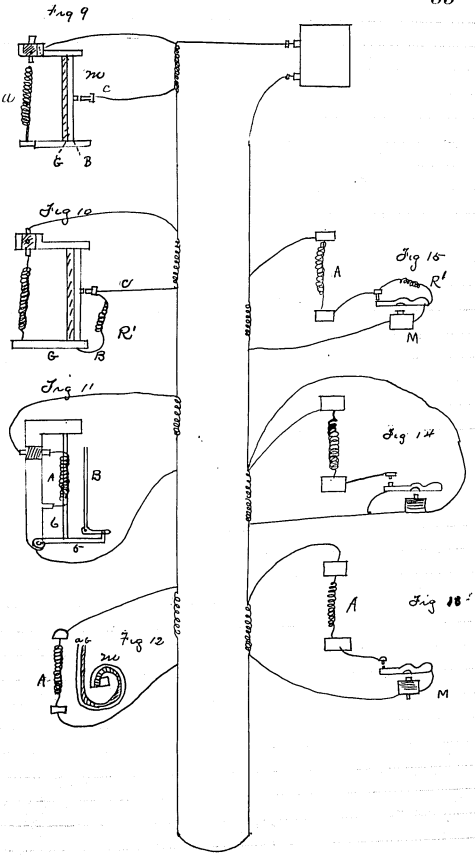
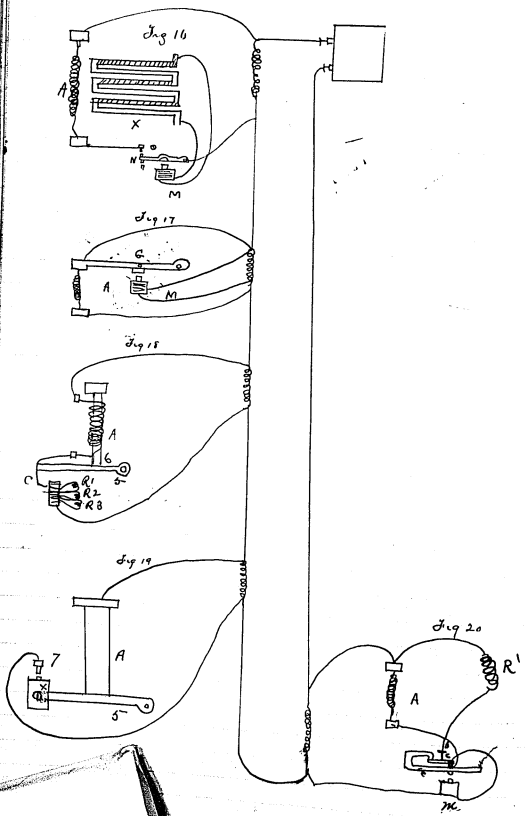
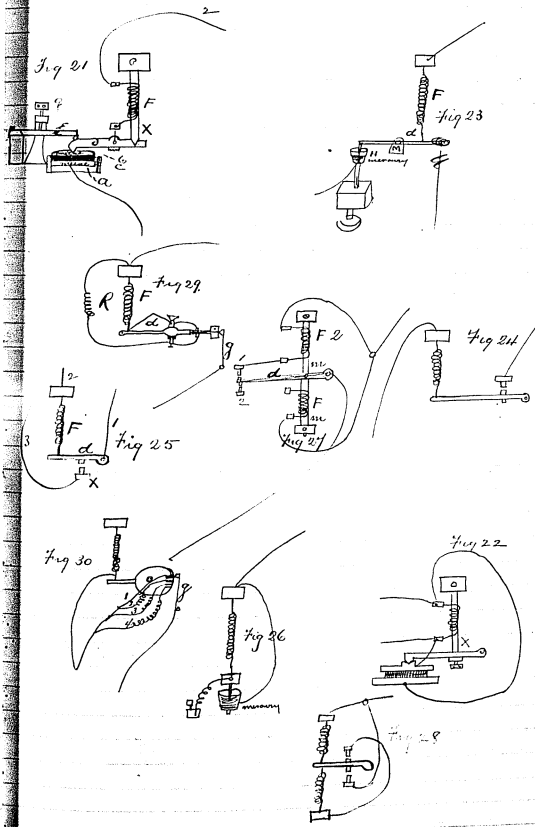


Fig 9
Fig 10
Fig 11
Fig 12
Fig 13
Fig 14
Fig 15
Fig 16
A
B
C
G
M
R'
m
w



Extension of Caveat for Electric Light Spirals



Extension of Cancel for Electric Light Spirals

Sept 13. 1878

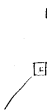


Fig 31

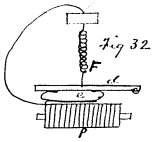


Fig 32

Fig 33

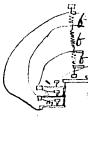
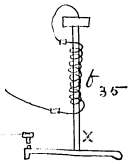


Fig 36



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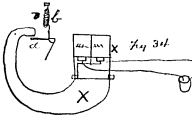
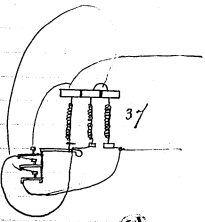


Fig 34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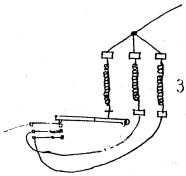

38

In figure 22 the arrangement is somewhat different. the expansion of the rod X by the heat of the spiral increases the pressure and decreases the resistance of the button hence cuts off more current from the spiral. thus reducing its temperature,

In figure 23 is shown a spiral F which when it expands throws up the lever. d & breaks contact in the mercury cup. H.
The rod may be arranged to short circuit the spiral F when the lever touches the mercury the spiral being placed in the other side of the fulcrum m.
Fig 24 shews the expansion of the spiral opening its own circuit and the contact point being placed near the fulcrum to gain power.
Fig 25 shows it arranged to short circuit the spiral when the temperature is to high the point X may be fixed as with a spring so that the spiral will not be affected when pressing the lever downward as it would if a rigid point were used.
Fig 26 shews a spiral with a light weight short circuiting itself in a cup of mercury or on a spring.
Fig 27 shews a double spiral F1 & F2 with lever d. connected to the expanding rods m and m' arranged with contact points 1 and 2 so that when f^2 is incandescent m will be expanded and the lever S will leave 2 and pass the current to F which in its turn will become incandescent and pass it back to f^2
In fig 28. this same principle is shewn with short circuiting connections
Fig 29 shews a spiral making a lever having two contact 1 and 2 on its extremity mounted from each other, a spring. 9 is either in contact with one or the other as the spiral is expanded or contracted thus opening or closing the circuit through the spiral or through a resistance

R equal to it but of large wire to prevent heating.
Fig 30 shows a similar arrangement except that as the spirals tends to elongate more and more it is checked by throwing in constantly increasing resistances 1. 2. 3. & 4

Fig 31 shows a spiral which is not heated, but a portion of its spirals touching each other and thus out of action when the passage of the current more and more spirals and consequently resistance is thrown in current by the expansion of the same

Fig 32 shows a method of gradually increasing the power of the shunt or short circuit. P is a cylinder wound with wire offering considerable resistance. It is a spring which when just touching. P comes in contact with but few spirals and as the length of the spiral increases the spring E flattens and comes in contact with more convolutions hence shunting more and more current from F

In figure 33 a coil of wire, gas or steam is to be immersed in the heat, may be used in the water to produce gas by decomposition in the liquid. augmentation in the current increases the gas and cools the spiral F.

Fig 34 shows an electric or other engine with a fan to produce a draft of air to cool the spirals the draft being regulated by the lever D covering the draft tube X.

Fig 35 shows the passage of the current through with the spirals F and a moving lever X thus working it by both direct and radiant heat. the short circuiting device may be used in this arrangement.

Fig 36 shows (3) three spirals in the same circuit with the spirals is an axial magnet - M with a lever O working springs 1. 2 and 3. when no current passes the springs 1. 2. & 3 short circuit the spirals F1 F2 F3 when current is closed the magnet causes the lever 1 to cut in circuit spiral F 3 if the current

strengthens the power of the magnet is increased and causes spring 2 to leave it contact point and cut in spiral F 2 and so on. the resistance of the spirals be sufficient to reduce the strength of the current. one spiral might be used and several resistances connected to the springs 1. 2. & 3

Fig 37 shows a similar principle: the power of the expansion of the spiral being used

Fig 38 is similar in principle.

Fig 39 shows a spiral F placed in a glass tube to prevent oxidation and allowing the spiral to become incandescent with less current than if a number of spirals in the free air E & B are caps for safety of some non conductor of heat.

Fig 40 shows concentric tubes the spaces between being filled with a solution of alum in water to further increase conservation and radiation of heat.

Fig 41 shows a set of relative positions of spirals.

Fig 42 shows a spiral with its regulator inclosed in a glass tube.

Fig 43 shows a spiral wound around a pencil of lime or similar substance to accumulate heat and thus render the spiral incandescent with much less strength of current.

Fig 44 & 45 shows several spirals regulated by a general regulator; for instance if there are 100 spirals in a building they may be arranged with three or four regulators instead of making each spiral do regulate — a straight wire is used as at X - which is not liable to change like the spiral. The regulation takes place at much lower temperature than on the spiral. I will mention that these spirals may derive the current from the main wire by being placed in derived circuits, or placed directly

in the circuit, or the ends of all commutators to one pole and all the other ends to the other pole; I will also mention that any source of electric power such as a battery or magneto machine of the usual construction may be used, but I am now engaged in experimenting on an improved magneto electric machine. I use a large tuning fork each prong being provided with a steam cylinder and valve which serves to keep the prongs in continuous vibration by steam power and forcing the prongs with electro magnets forcing other electro magnets and with suitable contact points obtain powerful induced current by the rapid approach and recession of the magnets

I shall probably claim.

1st Regulating the temperature of commutators heated by the passage of an electric current by their over expansion in the [illegible] by the resistant energy of the metal body substantially as set forth

2d The method of reducing the temperature of a body heated by electricity by causing its expansion to shunt the electricity from it and reduce the amount

3d A magneto Electric machine composed of a tuning fork or reed kept in continuous vibration by steam power as set forth and magnets and their commutators for the purpose set forth;

4th I claim the various devices herein described to carry out my invention in a practical manner for its various uses,

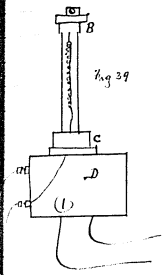


Fig 39

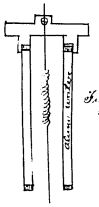


Fig 40

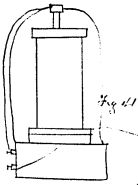


Fig 41

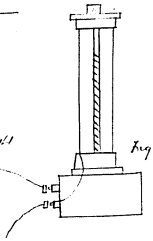


Fig 43

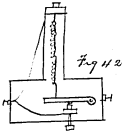


Fig 42

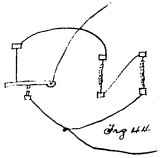


Fig 44

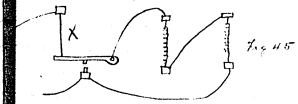
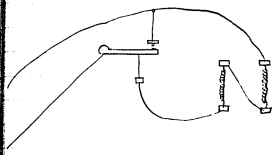


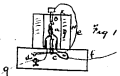
Fig 45

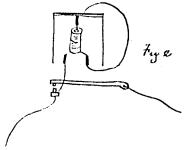
Burner No 2

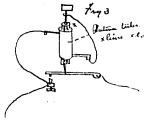
The object of this invention is to subdivide the Electric Light.

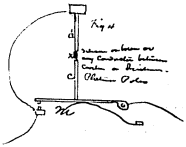
Sept 25. 1878.

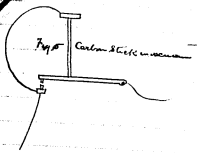


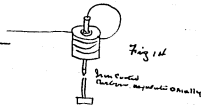




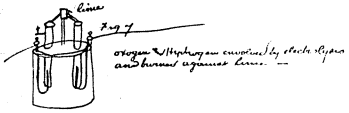


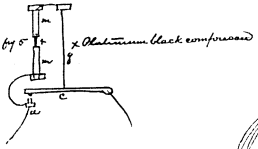


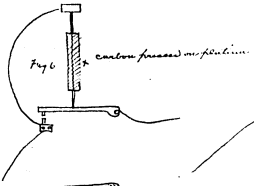


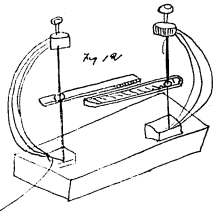


Sept 27. 1878









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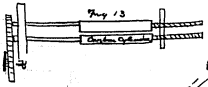
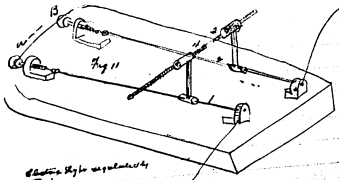
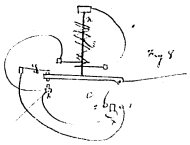


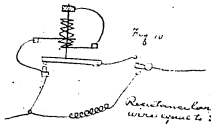


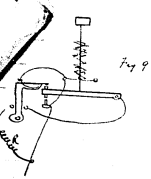
Electric Light separately Coralum

September 27. 1878

Electric Light







The object of this invention is to substitute the Electric Light

The invention consists in various methods of accomplishing this object which I am now experimenting upon

Fig 1 shows a right and left hand platinum spiral a placed in circuit and kept incandescent by the passage of the electric current. this spiral is placed within a glass tube K and this in its turn is placed in another but larger tube H. between this two tubes a non conductor of radiant heat is placed such as a solution of alum. although I hope to be able to dispense with the glass tubes altogether substituting solid alum tubes in their place.

The employment of a casing around the spiral to prevent the radiation of heat reduces the expense of the light as less electricity is required to give heat when the heat is thus accumulated to help keep the spiral incandescent. C is the regulating lever worked by the expansion of the wire B which is of the same size and passes through the spiral a and is included in the same circuit:

when the spiral is raised to incandescence that portion of the rod B which is small becomes incandescent expands and brings the lever C down on the point d and the current is shunted out of the spiral and rod B. they cool and contract the lever lifts from d and they again incandescent.

Fig 2 shows the platina coiled around a cylinder of a material which becomes incandescent from heat such as lime. chalk etc the proper substance to use I am now experimenting to obtain.

Fig 3 shows instead of a spiral of platina a cylinder of Platinum foil or around the lime

Fig 4 shows two platina wires c & c. between which a small piece of silicon, Boron, carbon compressed finely. Platinum Iridium osmium or Ruthenium or other substances which Conducts Electricity and becomes incandescent. The expansion of c c' and the substances used moves the regulating lever m and prevents the temperature rising to the point of destruction

Fig 5 shows a stick of carbon acting by its expansion

to regulate the temperature the carbon being placed with the other apparatus in a convenient tube to prevent vibration
Fig 5 shows a coil of compressed platinum finely divided metal such as Iridium Ruthenium or platinum which becomes incandescent by the passage of the current. placed in the same circuit is a temperature regulating wire q
Fig 6 shows a piece of Platinum wire reduced in size for a short distance from the centre and covered with carbon or other finely divided conducting material
Fig 7 shows Oxygen and Hydrogen produced by electrolysis and collected and burned in some cylinder. several diminished being included in the same circuit
Fig 8 shows the double platinum spirals S with regulating wire passing through it all arranged similar to fig 1 except that a switch x is used to cut the spirals out of circuit when not wanted which it does when the switch lever is in contact with the point R and when in contact with 1 it throws in a safety spring g. which shunts the spirals S around it. fuse and break the circuit allows the lever C to come in contact with it and short circuit the spirals
Fig 9 shows a better form the switch lever throwing the safety spring in position when wanted also has a resistance R which is thrown in circuit when the spirals is thrown out thus preserving an even resistance in the circuit
Fig 10 shows this latter device plainly but without safety appliances
Fig 11 shows an ordinary carbon lamp. B & H are the carbons secured to two arms which are in turn fastened to two screw wires 1 & 2 the amount of travel being regulated by the screws A & B. the carbons are made to connect and the arc produces a Refulgence
Fig 12 shows a modification of this principle
Fig 13 shows two carbon cylinders rotated back and forward by a spindle and screw upon it with reversable gear
Fig 14 shows the carbon sticks are coated with shown and the regulation takes place with an oval magnet.

I claim the various devices herein described
Menlo Park Sept 27. 1878

~~Electric Light Caveat No 3 Sept 27. 1878~~

Above is word W.C

Caveat No. 3.
Electric Light Subdivision.

The object of this invention is to subdivide the Electric Light and to make a Lamp which is self acting or controllable

The invention consists in the various devices for effecting this object. such devices I am now experimenting with to ascertain their availability for the purpose. I have already filed Caveats in which several forms of Lamps are shown and described.
Fig 1 shows the method of causing the rise in the temperature to regulate the temperature of the spirals by the expansion of the inclosed air. Q is the glass case made air tight. U is the incandescent spirals were D is the bottom frame work two air holes B. and B' lead from a chamber containing A into a space. C is a diaphragm air tight. when the spiral A becomes heated it instantly expands the air and this forces the diaphragm outward to a distance proportional to the rise in temperature in the centre of this diaphragm is a platinum wire K facing this is another platinum point I on the end of a flexible spring m when the temperature rises in a certain point come in contact and short circuit

the spiral at temperature falls and the air contracts the diaphragm recedes and the same operation goes on incessantly. It is an extra platina point called the safety "catch" this point is connected to the diaphragm. should the points K & i fail to make a connection owing to incs or to the temperature of a wire rise still higher (but not to its melting point) this wire force the spring m down and the spiral a will be short circuited. Just as if K & i had not failed an extra catch is arranged with the spirals which should at first wire close the circuit. these safety catches are shown in figs 2. 3. 4. 5. 6. 7 & 8 the two springs which hold the spirals in all cases are allowed to fall back or forward when the spirals melts and close the circuit

Fig 9 shows the secondary Battery S.B. arranged with the short circuit to prevent sparks in the points a small condenser might replace it.

Fig 10 shows a spiral filled with some non conductor which becomes incandescent at a low heat

Fig 11 shows a alternate spiral S. immersed in air or a liquid in a seperate compartment covered by a diaphragm the operation is obvious

Fig 12 shows the spirals S in a house worked by secondary Batteries S. B instead of the direct current the latter be used to charge the Battery m and its lever is vibrated rapidly by a self make and break spring or an electric Engine clock-work or other motor may rotate a commutator to accomplish the circuit changes

Fig 13 shows a spiral placed horizontally the two connecting wires being carried through a piece of chalk. C. or similar material m is Brass piece i and i'. to allow the exhausted air to remove the diaphragm K. outward and regulate the temperature of the spiral S.

Figs. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31 & 32. 33. 34. 35. 36. 37. 38 & 39 are different forms in which I propose to experiment with in ascertaining the best form for giving light by incandescence due to the passage of the Electric current through them

Fig 40 shows a regulating wire w and cone c of fine metallic foil left incandescent.

Fig 41 shows a simple method of regulating the temperature of the spiral S.

I shall probably claim regulating the temperature of a conducting body rendered incandescent by the Electric current by causing the expansion of air in which it is inclosed to move a diaphragm lever or equivalent substantially as set forth

2° The double contact points or safety catches substantially as set forth

3° The various arrangement of the incandescent Bodies

Menlo Park Oct 3. 1878

Thomas A Edison

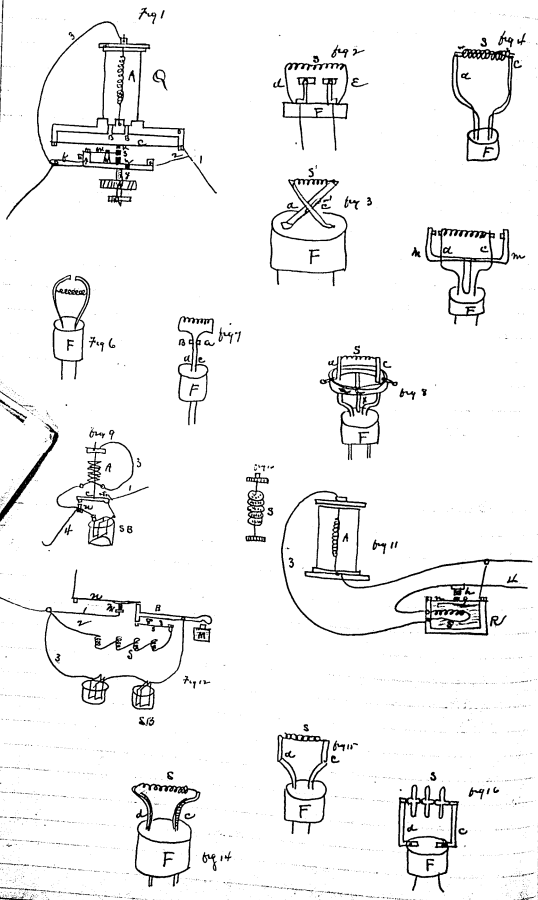


Fig 1
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Fig 16

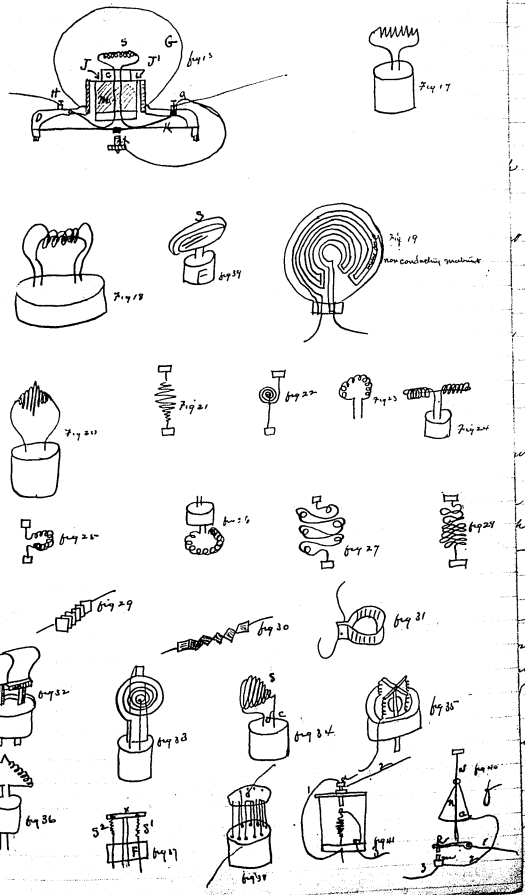
Fig 13
Fig 17
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Fig 19
non conducting material
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Fig 30
Fig 31
Fig 32
Fig 33
Fig 34
Fig 35
Fig 36
Fig 37
Fig 38
Fig 39
Fig 40
Fig 41

Electric Light Subdivision Caveat No 4

The object of this invention is to subdivide the Electric Light by causing the Electric Current to pass through conducting Bodies and render them incandescent

The invention consists in the various devices for accomplishing this object.

Fig 1 shows a piece of metallic foil A. through which the current passes. the top of this foil is secured to the top of the globe holding it at x an overhanging arm d is arranged so that the contact spring B rests upon it and places tension on the foil the extreme end of B is faced with platinum contact is made on a platinum faced wheel g this wheel is secured to a shaft which ~~secures~~ an upward or downward motion without turning by the action of the screw N. M is a rigid stud in which the devices are secured. on the shaft of the platinum wheel g is a ratchet wheel with two springs h & K engaging in its teeth when the screw N is adjusted downward the ratchet and wheel g is rotated about 1/16 of an inch thus bringing clean platinum for contact purposes every time the lamp is used with the wheel 1/8 an inch in diameter a fresh surface would be brought to face that on the spring B once daily for 24 days which is increased as we increase the size of the wheel. C is a small spring attached either to the spring B or to the frames of the instrument the object of this spring is to keep the foil A attached when the spring B comes in contact with the wheel g

Fig 2 shows a resistance R inserted in the circuit when the foil A is thrown out by the expansion acting on the lever L to separate it from the spring C.

Fig 3 shows in place of a resistance R. a second foil

Fig 4 shows a device for lessening the spark when the foil A expands and brings the points together the battery X acts to send a current through A in the opposite direction to the main current In fig 5 C is a chalk cylinder 1 & 2 are springs connected to it. between the springs is the foil A X is a cylinder containing a regulating wire in this wire short circuits itself as well as the foil A when the temperature approaches the melting point In fig 6 the short circuiting lever is worked by tension the expansion of the spring acting to bring the lever around to the short circuiting point

In fig 7 a rod R of silver placed in close proximity to the foil A when it expands to such an extent that it bows out and touches the silver In fig 8 A is the foil d a lever with a pad at c closing the orifice of the tube in through which a draft of air endeavors to pass when the foil expands to a certain degree the pad at c leaves the tube in and a draft of air passing to a malleable coils it by radiation

In fig 9 a double spiral is used to give light and a single wire for regulation

In fig 10 a carbon rod A dips in a molten mass of metal X in the carbon block B this gives brilliant incandescence. a carbon rod A should be fed downwards by proper mechanism as it wastes away

fig 11 shows two carbons 1 & 2 placed within short distance of each other and in contacts at their ends when no current passes. X is a platinum wire enclosed in the circuit and secured to the carbon 2 when the current passes X expands and with the assistance of the spring R separates the carbons and establishes the arc

Fig 12 shows the expansion of a spring X by the heat of the arc

Fig 13 shows double expansion wires A & B

Fig 14 shows two carbons 1 & 2 working on torsion wires the arc being maintained by repulsion

Fig 15 shows a fuse for incandescence on a piece of chalk it is rubbed in the center for strength

Fig 16 — 17 & 18 are similar

Fig 19 A is the foil B a weight short circuit takes place in a cup of mercury X

In fig 20 several levers No 2 & 3 are used to make contact should one fail the others connecting should all fail to connect with H and short circuit the foil it would also be saved by the stirrup S leaving the levers and the current passing through spring 7 and resistance R 6 is the adjusting screw for the contact H. 6 is a mercury cup to insure contact together of all the levers

In fig 21 springs replace the levers of fig 20

In fig 22 the object is the same as in fig 1 but rotation of the platinum wheel is obtained by the expansion of the fine rod X. every time the foil becomes incandescent a click in the rod engages in the ratchet on the platinum wheel

fig 23 shows an ordinary regulator with the addition of a lamp and wick which assists the incandescence of the foil and which for some purposes is a useful adjunct

Fig 24 — 25 & 26 shows methods of connecting the special in a magnetic electric circuit

Fig 27 & 28 shows methods of connecting several regulators in 27 they are connected for intensity in 28 for quantity

Menlo Park N.J. Dec 8. 1878

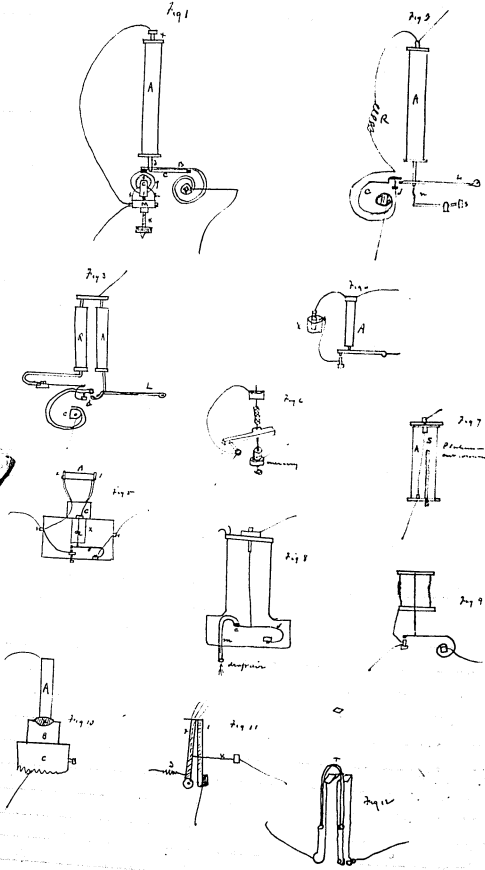
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Fig 12

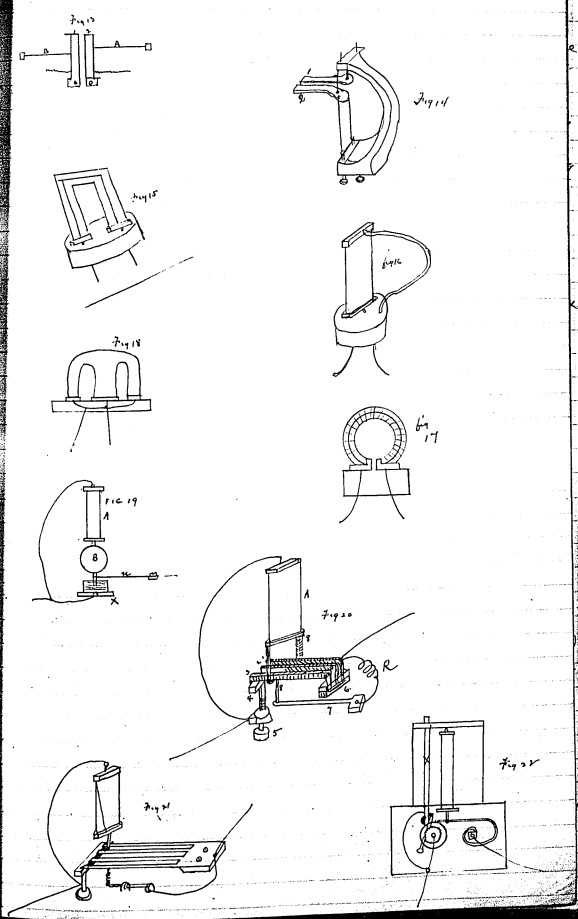
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Fig 22

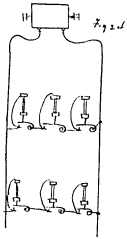


Fig 24

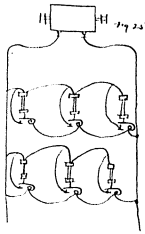


Fig 25

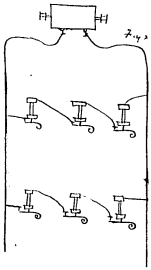


Fig 26

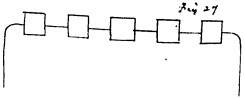


Fig 27

Fig 28

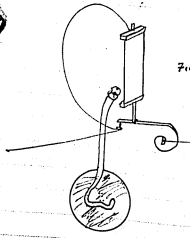


Fig 23

Electric Light Cutout No 1

The object of this invention is to subdivide the Electric Light by causing Cela Cela

Fig 1 shows a method whereby as the current increases in strength the foil A. Expands and rotates the lever B around the disc C by means of the shaft ne and string or cord N. The spring P serves to keep the foil A stretched X ~~F~~ is a flat foil on the face of the chalk disc C. this foil is included in the circuit when A expands the arm B moves to the left and cuts more of the foil X in circuit hence as the current strength increases more foil is thrown in circuit reducing the temperature of A hence A cannot rise in temperature to the melting point

Fig 2 shows a method to decreasing the resistance of the incandescent foil A when its temperature rises hence the temperature cannot rise above a certain degree. Upon the extension of A the lever B is brought in contact with a and a portion of the current passes through B. S. is a spring to keep the foil A stretched

Fig 3 shows the regulation of the temperature of the foil A by ~~stretching~~ short circuiting it. a second but smaller cloth B forming a part of the short circuit

Fig 4 shows the same short circuiting method with the addition of and extra device for throwing the incandescent conductor of our circuit when it is not to be used - throwing in circuit a resistance equal to it. so as to keep the resistance of the line perfectly constant. C & D are contact points operated by the disc X upon the upward movement of the screw g - when they are operated the foil A is cut of circuit & the resistance R thrown in

Fig 5 shows a method of throwing more or less foil in circuit by means of an oval magnet. X is the oval magnet C a pulley, on which a long strip of foil is wound. N is a weight to keep the foil stretched

B is a rod dipping in mercury through which the connection is made, when the current strength increases the core is attracted within the magnet shorts to a certain balance this gives relation to the drum C and the weight w imparts more force

Fig 6 is a similar arrangement w a spring X gives the downward motion. C is the drum carrying the foil and a an extra foil whose expansion allows C to rotate and more foils in circuit

Fig 7 shows a variable short circuit around the incandescent foil A. C is a block on which is wound fine wire a spring w when A expands flattens out and short circuits more or less of the wire on c c thus shortens the shunt around A

Fig 8 shows a similar device X is a spirial spring which acts as a resistance & downward movement of the lever in the expansion of a brings all the shorts together and forms the short circuit thus preventing any spark

Fig 9 is a similar device the rotation of the cylinder short circuits more or less of the springs upon the metal fingers B thus shortening the shunt

Fig 10 shows a shunt formed by a carbon button

Fig 11 is another modification of the carbon button principle

Fig 12 shows a sliding contact point x being the platinum

Fig 13 shows the sliding contact point which in this case does not short circuit the foil A but closes a local circuit containing a battery and magnet the lever of the magnet short circuits the foil A

Fig 14 is a similar device but the magnet is worked by a current from a derived circuit

Fig 15 the magnet does not make a platinum contact short circuit but one by friction thus preventing sparks

Fig 16 shows a rotating wheel with a piece of carbon w it more or less of this carbon is thrown in the shunt as the foil a expands or contracts

Fig 17 shows a device whereby an increase in the current produces increased length of foil a in expanding rotates cl and this having a large cam face (ca) being a larger wheel allow more of the foil B to unfold b is a spring to keep the foil stretched

Fig 18 shows an increased length of foil placed in circuit by means of a fine magnetism

Fig 19 shows a coiled shunt whose resistance is increased or decreased by more or less contact with mercury

Fig 20 shows two revolving contact wheels to move clean contact points

Fig 21 & 22 shows gradually diminishing operation of shunt by means of several springs arranged so that with a slight expansion of the spirial one spring comes in contact with its point and shortens the shunt and so on

Fig 23 a & b show devices for giving increased length of foil when the current strength is increased

Fig 25 shows is similar to 23 & 24 except the movement of the foil is obtained by mercury

Menlo Park Oct 16. 1878

Thomas A Edison

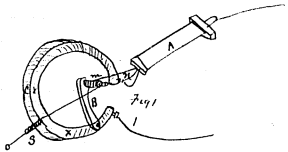


Fig 1

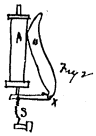


Fig 2

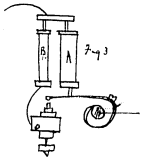


Fig 3

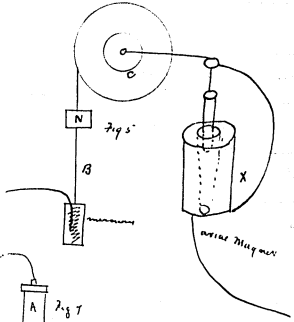


Fig 5

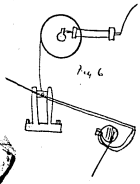


Fig 6

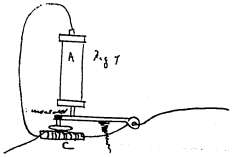


Fig 7

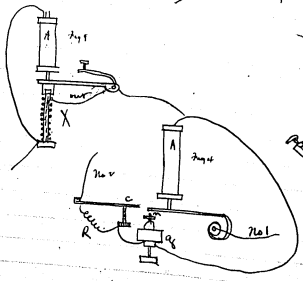


Fig 8

Fig 4

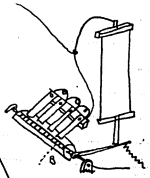


Fig 9

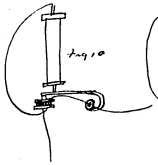


Fig 10

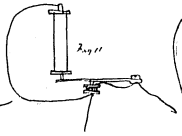


Fig 11

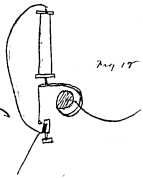


Fig 12

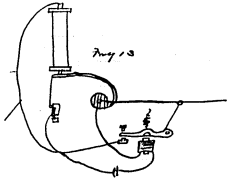


Fig 13

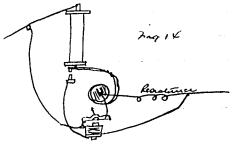


Fig 14

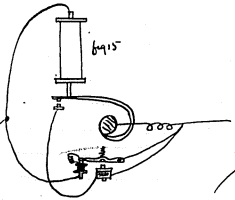


fig 15

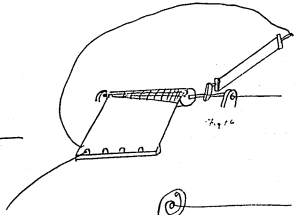
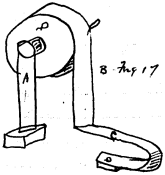


Fig 16



8 Fig 17

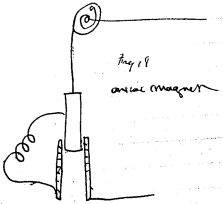


Fig 18
axial magnet

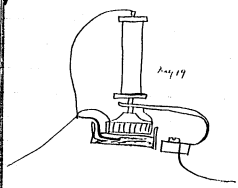


Fig 19

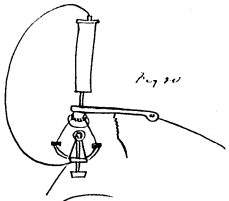


Fig 20

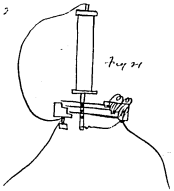


Fig 21

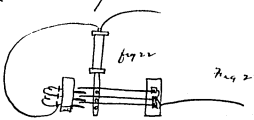


Fig 22

Fig 22

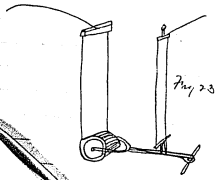


Fig 23

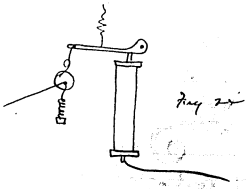


Fig 24

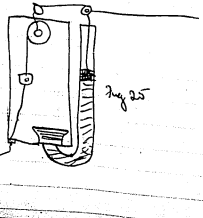


Fig 25

Caveat Electric Light

The object of this invention is to produce Light by concentration of heat rays of long wave length

The invention consists in combination with a reflector as reflector a source of heat whose radiant energy is received upon the reflecting surface either by direct radiation or by conduction and all the rays thus received being concentrated in a focus upon a small point of matter different of fusion. such as Iridium. Zirconi magnesia or lime. bringing the latter to avoid incandescence

In fig 1 – X is a mass of non-conducting material in an air space. R a polished reflector of Copper coated with gold or platinum P. I a platinum Iridium spiral X'X' also a sheet of non-conducting material. Z is a thin piece of Zirconi or Iridium which is the focus of R

Fig 2 shows a a a are a core of pipes containing steam or hot water the heat passes through the reflector R by conduction and the heat rays are concentrated upon Z as before X is a non conducting coating

Fig 3 shows how the reflectors itself may be made of polished tubing
Fig 4 shows a double reflectors with hot water or steam passing between I sometime employ Mg come as a non conductor of heat —
I shall claim
The method herein set forth of producing light by concentrated Heat of low temperature upon and in fusible substance substantially as set forth

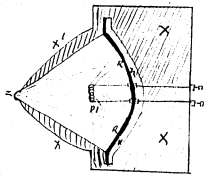


Fig 1

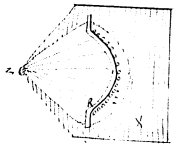


Fig 2

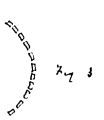


Fig 3

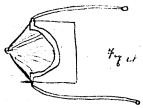


Fig 4

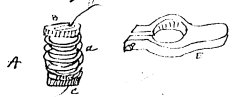
Menlo Park Jan 13. 1879

Carbon Electric Light

The object of this invention is to economically produce light by Electricity —

The invention consists in various methods and devices upon which I am now engaged in investigating with a view of adopting that which proves itself the most practical and economical

When using this incandescence of a moulded material to produce the light. and where the burner is to have a large resistance to admit of practical subdivision I use a coil of the material as in fig 1



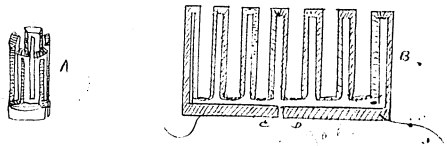
a is a cylinder of the best carbon cut in a lathe like a strong spring with two lugs or ends B.b which are used to secure a perfect connection with the leading wires. = is the clamp for making such connections By this means a resistance of thirty to fifty ohms may be obtained and with scarcely one inch of radiating surface. Of course an moulded conductor may be made in the form of a cylinder and made in this form either by cutting or grinding in a Lathe or by moulding directly —

Metallic silicon. or Boron may be moulded together like carbon. by powdering the silicon or Boron mixtening it with a highly decom-posed compound of these substances — mixing and subjecting them to high temperature just [illegible] silicon is moulded at a temperature [illegible] Various finely divided [illegible] metals may be combined with infusible oxides such as the oxides of Yttrium. Erbium. magnesium. Calcium

Common + analogous Earthy metals can be moulded or worked in this form

In fig 2 is shown another method of forming a burner of high resistances with smaller radiating surface.

Fig 2

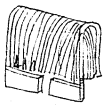


B shows the continuous conductor flat. C + D are the conducting plates of large surface

A shows the flat plates bent round to form the burner

Fig 3 instead of bending B form a round cylinder it may be bent as in fig

fig 3

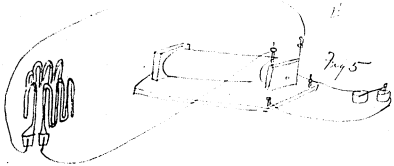


It may be formed in a volute spiral such lines being insulated from the other by an impervious non conductor as in fig 4

Fig 4

In fig 5 is shown a method of producing light by means of vacuum tubes having capillary bores it being known that the luminosity of the light from a vacuum tube through which a jump spark is passing is at the square of the diameter of the bore of the tube =

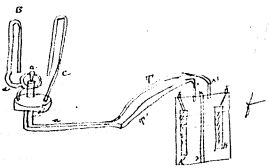
Fig 5 shows a length of tubing arranged like the conductor in fig 2



owing to extreme smallness of the bore and the concentration of a long length of tube in a very small space a very minute coil will give a light of several candle power =

Of course these capillary tubes may be wound in a spiral form

Another method is shown in fig 6



F is a decomposing cell with two electrodes H + K the liquids are seperated from each other by a

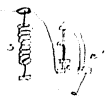
porous diaphragm which serves to allow the passage of the current but does not allow the gases to mix to any troublesome extent. The gas from Electrolysis which consists of Oxygen and Hydrogen are collected through the tubes t t' and conveyed by tubes T T' to the burner = as in bulk of lime. Zircon Magnesia or other infusible substances. d the jet which is formed of a tube within a tube one of which conveys the Oxygen and the other the Hydrogen in double channel. B is used through which either the Oxygen or Hydrogen passes from the cell of before & passes into the jet - d this is for the purpose of utilizing the heat from the jet to warm the gas or gases before passing to the jet =

I propose to construct a large Double cell with Electrodes composed of several bushels of Coke and divided by a porous diaphragm - with two generators the oxygen and Hydrogen are collected for use.

A dynamo electric machine is to be used to effect the Electrolysis = of course any number of lamps may be used according to the power of the machine this system is applicable to Country Houses where a water power or Wind mill power is attainable a concentration of light nearly equal to the Electric Light is obtainable and the economy is nearly as great the only loss being due to the heating in the decomposing cell by the prolongation of the Electrodes and the decomposition of the Ozone into inactive oxygen thus releasing a portion of the energy into the form of unavailable heat. This effect is reduced to the minimum when a single cell is used with a dynamo machine of great quantity - Instead of the jet of flame playing upon the cylinder of Zircon this latter may be fastened as a cup

and placed over the tube from which the jet proceeds as no atmospheric oxygen is required to support combustion as required in a small hole in the ground cup serves to allow the steam to escape =

Fig 7 Shows a new form of Thermal regulator for regulating the passage of the current through an non conducting material.



b is the non conducting conductor -
a is a cylinder or plate of protoxide of Iron or rather magnetic or black oxide of Iron, which is a non conductor when cold but has a conductivity as great as the metal Iron when red hot. this plate is placed between the upright ~~c c~~ and receives the radiant heat from the spiral - It is shunted around it. If the temperature increases to much in the spiral the plate at a certain point becomes a comparatively good conductor and thus shunts the current from the spiral. its heat drops and with it the conductivity of the oxides to be again renewed - The whole may be placed over the spiral to obtain the heat of convection as well as radiation - The breadth and mass of the oxides determines the point when a certain heat will render it suddenly a conductor

Small illuminated points may be obtained by employing Electrodes of Pure lamp black -

Menlo Park Feb 9. 1879

Caveat

Menlo Park N J Mch 17.79

The object of this invention is the perfection of various devices used in my system of Electric lighting.

The invention consists in means for generating electric currents ~~electric~~ ~~lamps~~ machines the power applied to generate such currents also in lamps for utilizing the electricity thus produced, a method of forming electrolytic gases, method of coating wire with a pyroinsulator and lighting by the passage of an induction spark through a line

Fig 1 shows a sealed glass tube x with bulbs at the end within the ends are two metallic discs connected to the terminals of an induction coil c which is supplied with current from a dynamo machine either with alternating currents or direct currents in the latter case the primary wire of the coil is arranged with two bobbins and the current alternately passed through on one or the other in contrary directions or by a self acting ~~contact~~ breaker or the coil is thrown in and out of circuit by the same device. Between the discs n m within the tube x is placed in the narrow part lime obtained from burning acetate of lime which owing to the immense quantity of gas formed when burning puffs the lime out greatly so that a cube 1 inch square will weigh less than $\frac{1}{10}$ of a grain in this state the slightest spark will bring it to vivid incandescence. The tube is exhausted of air.

Fig 2 shows a method wherein an Electro-Dynamo-Machine H is employed to generate a current wires 1 + 2 lead to a decomposing cell containing acidulated water the two electrodes a b are immersed in the liquid and are separated from each other by a porous diaphragm c thus making 2 sealed cells and allowing no gas to pass from one cell to the other > c + d are the binding

posts connected to the electrodes. f. g. are flexible tubes which connect to tubes which pass through the cover of the cells.

Upon the passage of the current decomposition takes place Oxygen is set free at one pole + Hydrogen at the other, these gases being separated are conveyed to the burners by the tubes. N is a double tube the ends one tube within the other the end of the inner tube being even with the end of the larger tube. P is a standard holding a piece of lime X reduced from the acetate. Upon electrolysis the oxygen rushes in one tube of n and Hydrogen through the other and they may be lighted at the end the flame playing upon the lime, a surprising small flame will bring the lime when in this form to a vivid incandescence whereas if allowed to play upon ordinary lime as used in the Oxy-hydrogen flame there would be scarcely any light. In practice instead of the cell shown I propose to use a long deep trough divided in two parts and each compartment separately by a porous partition in each side several bushels of coke is thrown and each batch of coke is connected to the electric conductor the gases due to electrolysis being either burned directly or collected in gasometers. By the use of a single large cell with coke electrodes and evolving the gases separately I am enabled to evolve large quantities of gas with a minimum loss of energy due to polarization which causes heat to be set free and by utilizing the gases so produced by burning them against the form of lime describes the light produced is equal in economy to that produced direct in the arc and may be made of 1 to 200 candle power subdivided indefinitely and stand up for

use. This system is especially applicable to country houses where a windmill-dynamo-machine & cell with gasometer is all that is required one hour's work of the mill storing up enough gas to last a week.

In Fig 3 is shown an improved bobbin of gas-insulated wire. The bobbin is of lime and the wire is of platinum, Iridium alloy gas-insulated. 1 & 2 are thick platinum wires to which the fine wire on the bobbin is connected these wires serve two important purposes 1st to convey the current from the bobbin wire to the base and the other to prevent conduction of heat downwards to be radiated. In my previous applications the lime extended down to the base this became hot by conduction and being a good radiator much heat was lost, whereas the platina wires though better conductors are very small and are very poor radiators another improvement in the bobbin is to make it exactly as thick as it is long as the greatest concentration of heat when it has this proportion. If it is twice as long as it is thick it will make a difference of 2 candle power in 16.

Fig 4 shows a ribbon of platinum-iridium gas-insulated which can be wound around the lime bobbin instead of the wire.

Fig 5 shows a method of coating the wire with an infusible oxide 1 & 2 are lamps whose flame heat the wire, 3 & 4 are stands having sponge on the tops moistened with the lime of magnesia solution resting upon these sponges are levers also having sponges upon their ends the wire passing through the sponge becomes coated with the solution & this is decomposed and the oxide deposited with the gas.

through the flame of the lamp.

Fig 6 shows the wire heated by passing through a hot tube. several hot tubes are used and the wire passes through moistened sponges before passing through each tube.

Fig 7 shows a lamp one bulb within another the inner bulb which is exhausted of air & sealed contains the light giving bobbin X is another sealed bulb coated with the lamp black and having a platinum-iridium wire sealed within it. this wire is in the same circuit as the wire upon the lamp. The end of the tube of this bulb connects to an inward diaphragm which serves to open & close the circuit of the lamp when the temperature rises above a certain point. Of course the wire within X may be dispensed with and the air within X expanded & contracted by the radiant heat from the bobbin an effect which is augmented by the lampblack

Fig 8. shows a wire for winding the bobbins composed of pure iron & platinum or other very refractory metal. the whole of the wire is to pyro insulated and wound in a bobbin this iron wire which is longer is wound within and the platinum wire which is finer covers the outside layer the current passing through both wires brings the platinum to incandescence and the iron wire to a yellow heat, which heat is not lost but must be radiated; conducted through and radiated by the platina. The object of this is to make the lamp of high resistance without loss of energy or light and use

a cheaper metal.

Fig 9 shows a new form of dynamo electric machine in which great concentration of field and cutting wire is obtained and at the same time the rapidity with which the cutting wire is passed through the field may be increased to almost any extent without increasing the rotating speed of the shaft. a is a ring composed of iron wire around this ring is coiled insulated wire in sections there being several hundred sections the wires between the sections are connected as in the Gramme machine to the Commutator. P is the field magnet which may be supplied with Energy from the ring a or from an external source. It is provided with the pieces p p q q p q which are shown in section in the actual machine these pieces entirely cover the ring except a small slit where the spokes of the ring pass to it. c is a commutator which in all positions of the ring connect to the bobbin between the field magnets. d. e are also springs both connected together and are connected through the commutator which with the bobbins on either side of the field magnets only that portion of the wire on the ring near the field magnet is used or adds resistance to the circuit the resistance of the wire length of magnet + concentration of the field is independent of the diameter of the ring which may be several feet. this is not the case with the Gramme ring as if we desire to increase the speed with which the wire passes through the field we must make the ring larger but this will increase the resistance and as the whole of the

wire should be covered by the field magnet it must be spread out thus weakening it hence the increase of resistance and weakening of the field prevent obtaining high speeds except by quicker rotation of the shaft which increases the friction.

When the wire on my machine which is passing through the field a circuit passes from the coil on each side of the wire from C down through it in the same direction and passes inwards through the two other wires leading from e + d.

Fig 10 shows this arrangement with field magnet in circuit with the ring wire.

Fig 11 shows a double field magnet with ring passing through the pieces at its centre the two north poles of the magnets are connected to one piece and the two south poles to the other.

Fig 12 shows the principle arranged with reciprocating mechanism a is a shaft b an eccentric x a magnet covered with wire which is reciprocated by the eccentric n n s.s. the field magnet s.s are south poles n n north poles a wire g is secured to the centre of the wire on x the two other extremities of x are connected together and from the other pole alternating currents are set up and these may by the use of a commutator be turned into continuous currents

Fig 13 shows the principle applied to a telephone d the diaphragm x the iron shell and wire reciprocated in the magnetic field by the movement of the diaphragm s. s are the south poles of the magnet and n n the north poles. the wires are connected as in fig 11 of course permanent magnets may replace

n.n. s.s.

I have shown a local battery L B to permanently polarize the magnets but these magnets may be placed in the main circuit with X and battery put on the line.

Fig 15 shows how the extra field magnet of a Gramme machine may be dispensed with and the ring itself be made a field magnet and cutting magnet at the same time.

Suppose X was a thermo battery or other source of electric energy the current would pass to the ring by the commutator springs 1 + 2 making the top & bottom of the iron ring n + s respectively & be a mass of iron only. 3 + 4 are the usual commutators if these be closed and the ring rotates the current set up tends to make a n pole on the right and a s pole on the left hence the polarity of the ring is at 90° to the iron pieces hence attraction which tends to retard the rotation and this sets up currents.

Fig 16 shows an arrangement by which continuous and alternating currents may be obtained from an ordinary Gramme ~~the commutators are either closed or arranged~~ with the wire on the field magnet so that the current set up in the machine will energize the field magnet at a point at right angles to the commutator springs both on the top & bottom of the ring the continuity is broken and the two ends of the wires are taken to discs upon the shaft upon which springs rub these springs have wire connected to them and if these wires be closed continuous currents will be taken off by 1 + 2 and energize the field magnet while alternating currents will pass through the circuits. e.g. 7 + 8 are to circuits connected to Carbon points to form an arc lamp.

Fig 16 shows only the top of the ring cut and its two ends connected to discs or rings upon which the springs n + m rest.

Fig 17. Shows a dynamometer for measuring the amount of horse power absorbed by the dynamo machines while supplying current. M is several cone pulleys connected to a shaft a. These pulleys are connected directly by belts to the main shaft. 1. 2 + 3 are insulated discs with springs resting upon them

g is a disc connected permanently to the shaft a

H is an electro magnet also connected also connected permanently to the disc g. It has an armature from the end of an arm which is secured to a loose pulley X also upon the shaft a from the pulley X a belt leads to the dynamo machine the springs 1 + 2 connect with a battery B resistance coils C and galvanometer D. 2 + 3 connect with the magnet H 1 + 2 connect with the disc g and back point K forming a circuit when the arm from X rests against K in which circuit a bell and battery is placed.

When it is desired to test the amount of power absorbed by the dynamo machine the battery B is put in circuit and H attracts the arm of X and locks it to g rotation takes place. The operator now watches the galvanometer and commences to insert resistance until the power of the magnet is so weakened that the armature on the arm of X flies from it striking K this closes the bell circuit and just as the bell strikes the operator notices the deflection of the galvanometer which gives the strength of the circuit and having previously determined the amount of weight which would pull the arm away with different strengths of currents is enabled by taking the speed of rotation to accurately determine the power absorbed in foot pounds.

Fig 18 shows a quantity dynamo electric machine. S is a shaft m a magnet with wires the two ends of the wires are connected to discs 1 & 2 c c are shells of copper which envelope the magnet m at the center the shells connect electrically with the iron of the core of the magnet m on the end of the shell are pulleys of metal flexible wire rope serve to give rotation to these shells and also convey the current these shells rotate in opposite directions. The currents thrown in them pass through the iron of m and the shaft becomes one end of the circuit while the pulleys & wire ropes are the other ends One shell supplies current to the field magnet m

I will mention that for regulating the strength of the currents in a Gramme machine that the two Commutator springs or brushes may be connected to a rotating disc and if placed at right angles to their proper position no current is produced or power absorbed by the machine but if turned the slightest toward the proper position to obtain a maximum current then a current is set up in proportion to this movement hence by turning the commutators we can obtain any strength of current we desire without stopping the machine or causing any greater absorption of power than is necessary to generate the current

Claim. 1st producing light by an induction spark passing through lime as prepared in a vacuum

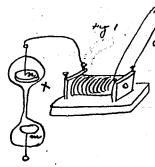
2d The use of lime thus prepared in the Oxyhydrogen light

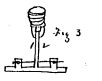
3d Producing Oxygen & Hydrogen substantially as described (ic) with Coke-porous diaphragm

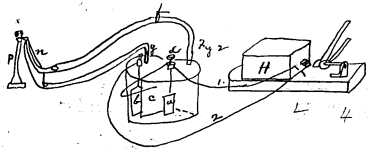
4th A dynamometer substantially as set forth.

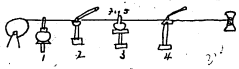
5th The method of obtaining continuous and alternating currents from a Gramme machine

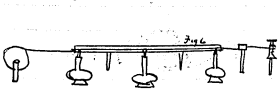
6th The Dynamo Electric Machine shown in figs 9 10 & 11 etc

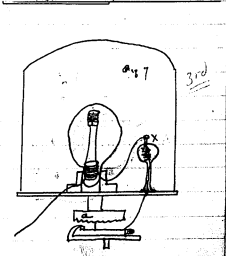












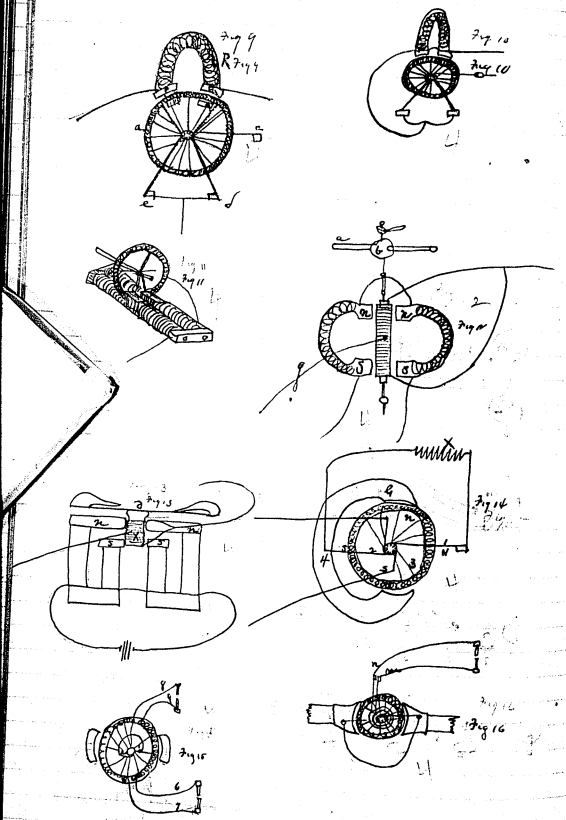


Fig 9
R Fig 9
Fig 10
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Fig 11
Fig 12
Fig 13
Fig 14
Fig 15
Fig 16

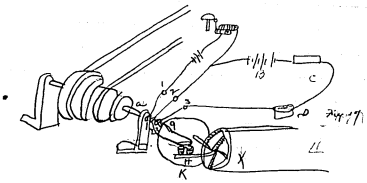


Fig 17
K

Caveat

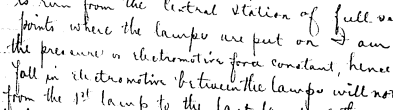
The object of this invention is to economically sub-divide the Electric light.

The invention consists in various devices to produce an even or equal electromotive force in the circuit, to moderate the power of the light without the interposition of devices wasteful of the electric energy.

Various devices to automatically regulate the electromotive force.

The method of arranging the conductors in peculiar proportions that a street one quarter of a mile is to be lighted and 1000 electric lamps are to be used all arranged in multiple arc. I first run two conductors 1/4 of the distance from the central station of a certain size and electrical resistance to this point. If put no lamps across the two wires, the remaining distance I enlarge the conductors commencing very large & tapering down to the size from the station or below that size, on these conductors of increased size I place say 250 lamps, again from the central station I run two other conductors to 1/2 the distance or 1/4 of a mile & there connect enlarged conductors until a point is reached where the large conductors commence on the first circuit, on this conductor I put 250 more lamps, then another circuit 3/4 of a mile is run from the central station of full size, thus up to the points where the lamps are put on I am enabled to keep the pressure or electromotive force constant, hence the difference of fall in electromotive between the lamps will not take place gradually from the 1st lamp to the last lamp of the 1000 lamps as it would if they were all on one circuit but will only fall between 250 lamps in 2 cases and 500 lamps in one case but if the circuit containing 500 lamps is split up into two circuits then the fall will be very between the extreme of 250 lamps

Fig 1 represents 3 circuits



1 & 2 represent the lamp wires of the longest circuit N is the central station C.C. are the smaller leading wires connecting at B B' with the enlarged tapering conductors, x x x are lamps 3 & 4 the 3d circuit & 5 & 6 the shortest circuit. The electromotive force will be the same at B B'. K K' M M' hence the difference in the amount of light given off by the lamp nearest the station and the one farthest from the station will only be 1% per cent under the most favorable condition. The drop in the electromotive force between the circuits with no lamps upon them and when they are all on is independent of the unavoidable drop between the lamps & may be controlled by hand or by automatic devices. When controlled by hand a small wire should be connected to the end of every circuit and returned to the central station and there connected permanently with an electrometer by which any drop in the electromotive force can be seen at once and the rise in the electromotive force may be obtained either by increasing the speed of the engine or of the Dynamo machine or "Exciter" which serves to supply a permanent current to the field magnets of the inductor bobbins of the machine of the main conductors. The rise may also be to a certain extent be effected automatically. Thus; the field magnets being supplied with current from an Exciter and the induction bobbin connected to the line in multiple arc, the latter has one end disconnected therefrom and the field magnet wound with a separate coil, over the regular coil, and the bobbin wire connected to one end the other end being connected to the main conductor.

This extra coil has but a fraction of the resistance of the induction bobbin thus without this bobbin the current from the exciter would acting in the field magnet coils give sufficient magnetism to cause the induction bobbin to show an electromotive force of 95 volts which is raised to 100 when the extra coil is in circuit. If now lamps are placed on circuit they tend to cause a drop in the electromotive force of the induction bobbin but the amount

of current taken from the machine being increased this reacts on the extra coil to create a stronger field magnet and the drop is prevented, this device is efficacious when the field magnets do not approach any where near their point of saturation.

Another method consists in winding an extra coil on the field magnet of the exciter itself of very low resistance and interpolate it in one of the main conductors so that all the current which comes from the combined bobbin shall pass through this extra coil.

Another plan consists in connecting all the extra coils of all the main machines in Multiple arc and interpolating the combined conductor in the main circuit so that the whole current shall pass through the extra coils.

The method to increasing and decreasing the amount of light from the lamp is as follows and is shown in fig 2.

a is the burner b c the platina wire supports X is an Electric Engine having a resistance 200 times less than the lamp when the latter is giving maximum light; K is the rotating armature which is kept in rotation by having the magnet short circuited by break n spring m & shaft revolving time the armature approaches the poles. The short circuit wires are 22 + p (dotted line to represent the back) Q is a break wheel on the revolving shaft at the bottom of this wheel there is but little metal the most part of its circumference being insulating material the amount of metal on the periphery gradually grows greater until near its top when the whole circumference is metal on this rests permanently a contact spring

or roller h connected to the lamp by wire 24 on the lower part rests a spring f which by means of an adjustant can be slid up or down Q by the screw g the current entering at 23 passes through the lamp thence to h through the metal of Q and if the engine is revolving passes to f each time the metallic portion of Q comes in contact with f thence by 20 through the magnet & to 23 while the Engine is revolving the amount of metal on Q being 8 times less than the insulating substance the lamp only receives 1/8 of the energy which it would receive when the surface of Q wholly metal and this amount of energy is wholly independent of the speed which Q revolves this will cause the lamp to be brought only to say a dull red. If now the spring f be raised the amount of total contact will be increased and more energy will pass to the lamp and by this means the spring f may be raised until it is at a point where the surface of Q is wholly of metal. In practice I arrange Q so that f when down to its lowest limit it rests wholly in insulation, an extra appliance or lever is arranged with the screw g whereby an initial motion or start is given the shaft of the engine when the lamp is to be turned on.

It is obvious that any form of magnetic motor may be used to give a constant rotation to Q even a clock work would serve to give sufficient motion it being wound up in the act of turning on the lamp, or a hot air motor ~~obtaining~~ using its heat from the lamp might be used a vibrating fork, lever, reed may be used.

Claims.

1st The system of electric conduction substantially as herein described

2d The methods herein described for regulating

the electromotive force in an electric lighting system.

3d – In combination with an electric current of a moving break wheel or analogous device of variable conducting surface so that the circuit may be closed for a greater or less period at each revolution or movement by moving a contact spring over its periphery for regulating the total energy passing in a circuit

4th The electric engine X in combination with the revolving break wheel C for the purpose set forth.

Menlo Park N.J. July 20. 1879

To All whom it may concern

Be it known that I Thomas A. Edison of Menlo Park in the State of New Jersey have invented an improvement in the Telephone of which the following is a specification as far as perfected.

The object of this invention is to transmit sounds to a distance over electric circuits and thereby as telephones.

The improvement consists in various mechanical modifications in my carbon telephone.

In my application No. 158 filed Nov. 11th, 1878 I have shown the increase and decrease of pressure on the carbon button by the momentum or inertia of a mass held against and moving with the diaphragm.

The following are modifications of the same

Fig. 1 shows a carbon button E secured to the diaphragm N. A is a weight with a platanized screw o passing through it and resting upon the carbon button. B.B' are springs which serve to hold the weight A in position. The amount of initial pressure may be regulated by the screw o. L & M are the circuit wires connected to the primary coil of an induction coil with battery in circuit. Owing to the inertia of the weight and not being able to follow every rapid movement of the diaphragm there results a difference of pressure between the screw o and the carbon. The screw may be also tipped with carbon in fact instead this wafer of carbon may be used or a disk or piece of any shape may be used. The weight A may be round square hexagonal oblong oval or in any configuration so long as it is a weight. It may be a hollow sphere cube or other shape and be filled with mercury or any other heavy substance.

The springs B.B' may be broad or narrow and may be bent in any shape between the weight A and disk upon the diaphragm

In Fig. 2. A and B are pieces of carbon or other finely divided

conducting matter secured to the diaphragm N. each carbon is connected to the circuit; when in a state of rest the two ends are in a state of rest the two ends are in contact with each other.

The amount of initial pressure being regulated by the boring inwardly the diaphragm by the spring C and screw D.

Fig. 3. shows two flat carbons A, B. secured to the diaphragm N and adjusted so that the ends are in contact, the boring outwardly and inwardly of the diaphragm from the normal position tends to increase or decrease the initial pressure.

Fig. 4 - shows an inertia transmitter, E is the diaphragm a. is rubber, or other diaphragm. B a spring serving to force the weight C in position D is an adjusting screw whereby rest on the carbon discs X - The operation is the same as fig. 1.

Fig. 5. shows a double inertia transmitter the two carbons X X being connected together hence the difference of pressure takes place at two points.

I will mention that the carbons of either figs 1. 4. or 5. may be fastened to the cups permanently or they may be loose: the latter is preferable.

Fig. 6. shows an inertia telephone E is the diaphragm N. the carbon button. C the rubber standard A the weight which is of iron and is secured to the spring B which may be made adjustable. M.B. is a permanent magnet which may be made to approach or recede from the weight A and thus increase or decrease the initial pressure on the carbon.

Fig. 7. shows one of these transmitters secured to a diaphragm E which in its turn is pressed to a larger rubber diaphragm F.

Fig. 8.

shows another form of inertia transmitter. C is the

Fig. 9.

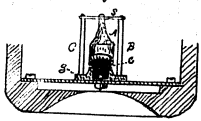


Fig. 11.

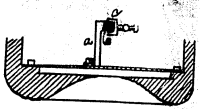


Fig. 10.

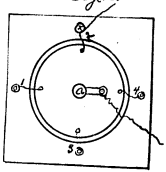


Fig. 12.

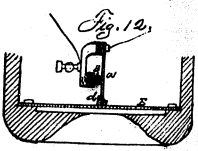


Fig. 13.

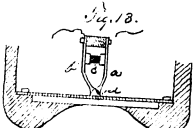


Fig. 14

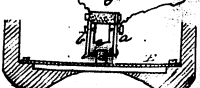


Fig. 15.

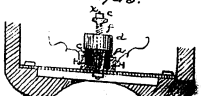


Fig. 16

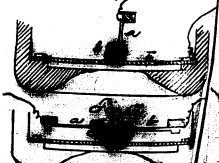


Fig. 18

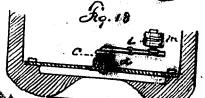
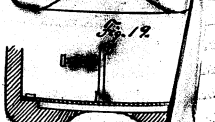


Fig. 17



carbon. It is moving both in a tube with an opening at [illegible] and the whole secured to the diaphragm E.

Fig. 9. Shows another form C and B are uprights secured to the rubber piece g. which is secured to the diaphragm, S is the carbon which rests on the platinized surface of a screw which serves also to connect g with the diaphragm A is a weight. S is a spring which serves to give to A an initial pressure and holds it in position a screw may be connected from the spring S. to the point of A and thus made adjustable. The operation is the same as in Fig. 1.

Fig. 10. Shows a diaphragm with the inertia transmitting device upon it and secured to the wooden case x by springs or elastics. 1.2.3.4.

Fig. 11. Shows an upright a. the upper end of which is platinized and rests upon the carbon disc B which is in the adjustable cup c. The movement of the diaphragm increases and decreases the pressure upon the carbon.

Fig. 12. Shows another transmitter. E is the diaphragm a is a spring lever which is given a side motion by the movement of the diaphragm; by means of a lead piece d. B is the carbon button against which the spring a rests and closes the circuit. the pressure is regulated by the movement of the diaphragm.

Fig. 13. has double lever a. b. c is the carbon d serves to separate both levers simultaneously and they carry their carbon button with them.

Fig. 14. Shows a block d connected to the diaphragm E. in this block is a hard carbon rod c. against which the springs a. b rest. they are bolted; any outward movement of the diaphragm tends to increase the pressure

Fig. 15 is an inertia telephone with two carbons a. c. connected together: resting on these carbons is the weight d which is kept upon them by the spring f. around the insulating rod x. e is a nut for increasing or decreasing the tension of the spring.-

Fig. 16. is the same as fig 14 except a wheel b of carbon is used.

In Fig. 17. the diaphragm E has a block d to which is secured a carbon c. resting on this are two springs a and b the forward movement of the diaphragm increases the pressure at both points of contact.

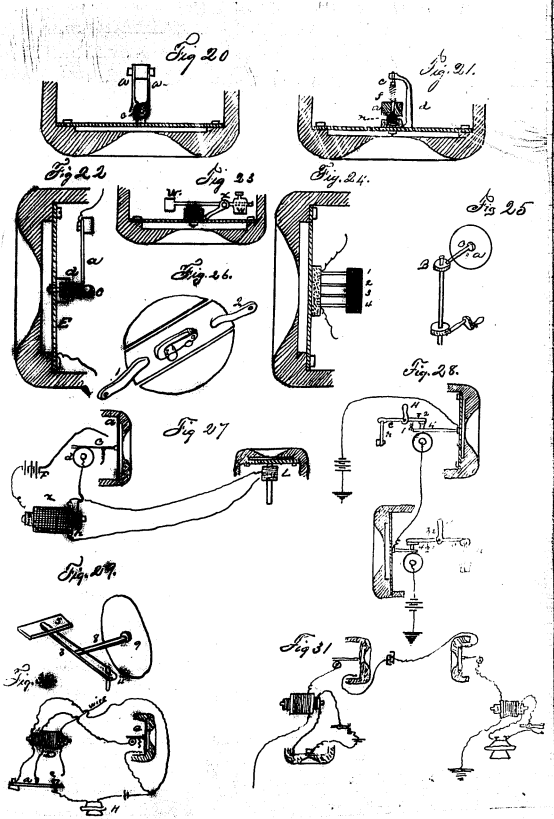
Fig. 18. shows a cup d. with carbon rod c. in it resting upon the carbons is the lever L the initial pressure may be varied by the electro magnet M. which may be the primary coil of the inductorium or disconnected therefrom, or it may be a permanent magnet or even a special or flat spring may be used or if the diaphragm is held in the right position its own weight may be used.
The device shown in fig. 19. is similar to that in Fig. 14.

Fig. 20. shows a wheel of carbon c and double springs a. a. used and operated in the same manner as in fig. 16.

In Fig. 21. d is an upright in the base of which is the carbon M. on this rests a weight a. a hole being drilled through it into which passes the rod around which the adjusting spring f. is coiled; this serves to hold the weight in position by the nut c the initial pressure may be regulated.

In Fig. 22 E is the diaphragm. d the carbon a a semicircular spring with carbon tips upon its extremity resting against the carbon connected to the diaphragm. C is a weight.

Fig. 23. shows an inertia transmitter. W. W' are weights secured to a lever pivoted at x form an arm which



connects with a diaphragm. The center of this lies upon a carbon button in the cup upon the diaphragm. W is adjustable so as to adjust the initial pressure.

Fig. 24. Shows a receiver based upon the two springs some of are insulating blocks upon the diaphragm the current enters via spring 1 thence through the carbon lips to the carbon lips C & S and out by the spring 2.

Fig. 25. Shows a receiver based upon the electromagnetic principle. A is the diaphragm B a disc of steel or other such substance attracted with strength of some other proper chemical to produce the mechanical action the spring C connecting the diaphragm with the disk. B is lifted with vulcanite. The shaft of the disc is secured by a screw and worm wheel E.

Fig. 26. Shows an India telephone secured to a strip of steel material called a diaphragm. It is held against its case by springs 1 and 2 which are tipped with rubber or other soft substance.

Fig 27. Shows the microphonic receiver arranged as a transmitter. A is a diaphragm C the spring connecting the same with the shaft d. The shaft d is not rotated this apparatus is inclosed in a primary circuit of an induction coil x. E is the coil which has a high resistance F is a battery L is a magnet receiver or it may be an exact copy of A. The action is as follows:
When the diaphragm A is shaded by the voice it sets in motion the spring C this instantly deposites the point of contact between it and the shaft d thus increasing the flow of current from F the resistant C comes to rest it polarizes and weakens the current from F

Fig. 28. Shows the microphonic arranged to transmit direct from one to the other without the intervention of an induction coil also arranged so that the sound by raising a lever C.D. is made receive or transmitter. A is the rubber pressure which presses the spring from the diaphragm down upon the shaft when receiving. C is the lever with handle D. 1 and 2 are insulating strips. B is a spring with roller which serves to hold the lever when it is drawn up or down both instruments are alike. When receiving the pressure is put on the spring resting upon the shaft and it is rotated but when transmitting, the pressure on the spring is light and the shaft is not rotated.

Fig. 29. Shows a telephone in which each sound wave is made of an aggregation of smaller waves. S is a lever pivoted at P near the fulcrum H. is arm arm 8 connecting it with the diaphragm A. 5 is a block of firmly seasoned sounding wood the end of S rests lightly upon it the block 5 is connected to one part of the circuit while S is connected to the other part, the vibration of the diaphragm causes to respond the spring 8 and the motion of 5

Fig 30. Shows a push button arranged to show the receiver circuit when transmitting and vice versa upon the transmitting circuit when receiving thus preventing the battery or primary coil of the induction from short circuiting each other circuits. X is the push up to lever which up the battery coil D. is connected through the primary with the receiver C when down the carbon transmitter A is connected in circuit and the battery circuit broken at B.

In Fig. 31. the two chemical receivers are in the main line with a condenser, the latter to prevent the circulation of earth currents through the shaft and thus neutralize them. The battery coils are thus disposed with.
I not mention that steels, buttons, a disks of finely seasoned sounding matter may be made of the following named materials. Carbon, Lampblack, Anthra-

Sic Coal, Bituminous Coal, Anthracite Coal, Gilsonite, Petroleum Carbon, Lamp Carbon, Gas Carbon, Carbon from Burning Organic Matter, Phosphorus Carbon, Shaped Diamond, Crystalline non-organic Matter, Graphite (Plumbago), Black Lead, Carbonate of Iron and the Carbonate of the Metals, Metalized Carbon, Metalized Graphite, Metalized Black Lead, Metalized Lamp Black, Peroxide Lead, Peroxide Manganese, Oxide Copper, Sulphide Tin, Sulphide Iron, Sulphide Copper, Sulphide Antimony, Sulphide Nickel, Sulphide Salt, Sulphide Copper, Sulphide Bismuth, Sulphide Lead, Selenide Cuprite, Sulphide Sulphide Chromium, Sulphide Mercury and all the conducting Sulphides, Nitrate Potassium, Nitrates, Nitrites, Platinum, Palladium, Iridium, Zinc, Copper, Lead, Tin, Iron, Chromium, Titanium, Aluminium, Selenium, Tellurium, Carbon, Bismuth, Boron, Cobalt, Calcium, Barium, Calcite, Columbium, Didymium, Erbium, Glucinium, Cerium, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Niobium, Osmium, Palladium, Amorphous Phosphorus, Iridium, Rhodium, Silver, Sodium, Strontium, Tellurium, Thorium, Tungsten, Uranium, Vanadium, Yttrium, Zinc, Zirconium, Magnesia, Oxide of Iron, Dampier, Calcium.

Any known substance which conducts electricity and which can be powdered may be mixed by itself or mixed with one or more other conducting or non-conducting substances to form the tension regulator for a telephone.

For making the case of the telephone any known wood metal or manufactured or native substances may be used.

I shall probably claim all the devices substantially as herein set forth.

Signed by me this 7th day of Aug. A.D. 1879

(Signd) Thos A Edison

Witness
S. L. Griffin
Chas Batchelor

The object of this invention is to produce carbon conductors of high resistance to produce the electric light by incandescence.

One of the materials I employ is made by taking commercial lamp black and subjecting it to high heat in a close crucible afterwards the lampblack is mixed with tar until it is quite sticky, it having now will mixed more lampblack is added from time to time until it becomes of a consistency that it can no longer be worked in by a spatula or in a mortar. It is then pressed in by rating and twisting until it has just sufficient plasticity to allow of being pressed out in a flat plate to do this a small piece is rolled by the fingers until it is in the form of a cylinder or rod. It is afterwards rolled out to the proper length and thickness by placing it on a true flat piece of wood and rolling it back and forward when it has reached the proper shape it is dusted over with a powder which is non-combustible, this prevents it sticking to any substance in which it may come in contact - a mandrel has upon it a copper spiral composed of silver wound or made with it and afterwards like a washer the plastic carbon rod is wound between the turns of the copper spiral and the latter is pressed together thus flattening the sides of the plastic carbon and giving it the same shape as the copper spiral. The ends of the plastic carbon is then bound to platina wires by placing two ends of the plastic material at the point where the platina wire is inserted in the plastic carbon the wire and copper spiral is then clamped in a proper frame work the mandrel is withdrawn and the former placed in a recess in tube and subjected for a few minutes to a gradual increase to a white heat the volatile part of the tar being drawn off and the remainder carbonized locking the lampblack particles firmly together and making a stiff spiral. While being carbonized the plastic material shrinks considerably and this is the main difficulty of the operation of the manufacture and I am now engaged in perfecting the mode of making so as to produce these spirals cheaply, after carbonization the copper spiral is eaten away by nitric acid leaving only the carbon with the platina wires. The latter are by

the act of carbonization some firmly attached to the carbon so much so that it is with difficulty that they can be detached and the resistance of contact between the carbon and metal is much lower than it would be if the carbon was pressed against the platina by a clamp with sufficient power to weld the parts. One reason why platina wire for the carbon makes a superior contact is that combustion during carbonization produces a powerful pressure between the carbon and platina and another reason is that at the white heat of carbonization platina is attacked and combines with the carbon. Due to the discovery I am enabled to obtain a good contact between the carbon and leading wire without the necessity of clamps which are so rapid a resistance would be difficult if not impracticable, with the ordinary methods of manufacturing carbon the difficulty is not so great, as the carbons are made very homogenious by the use of hard carbon particles and the several dippings and carbonizations which they undergo to make them more solid and of low resistance. A spiral of carbon formed of lamp black is far more homogenious under the microscope than a carbon one made in the ordinary way but which has at least 10 times the weight of the former. My great object is the production of a carbon with of the highest possible resistance that will have as low resistance as I have discovered that no matter how rare the carbon is if placed in a vacuum wherein to the millionth of an atmosphere; that this space is sufficiently void of oxygen to cause the conductor to be absolutely stable by means of boiling the plastic carbon in the form of a spiral I am enabled to use a greater length of carbon and of greater mass without unnecessarily increasing the radiating surface thus I can use a more homogenious carbon and have a higher specific heat given the lamps thus lengthening the cooling time of the same and make it less responsive to changes in the strength of the current by this means I obtain a lamp of sufficient high resistance to allow of the subdivision of the electric light practically by placing the lamps in multiple arc. The resistance of the plastic carbon may be increased by mixing with it

while plastic powder which are insoluble such as graphite powder, or powders which are of such highly attenuated minute such as starch, fine sand may be used as this becomes insoluble at a high temperature magnesia graphite which is low compact may also be used, even slate carbon may be used which should be finely ground and mixed with some non conducting substance to separate the particles. Whatever it may be of such low resistance as to require a great length to obtain the requisite resistance and a consequent increase in the radiating surface and time of energy a hollow of fibrous carbon may be formed by winding within the copper spiral one layer and covering the whole with paper over which another copper spiral is placed into which a second layer is wound the copper spirals might be dispensed with and the plastic carbon rod sealed with shellac or starch is formed in one or more layers one over the other upon a mandril which is afterwards withdrawn, the whole subjected to carbonization after which the carbon rods is sufficiently stiff to hold in position each rod being separated from the other by the shrinkage of the shellac or the destruction of the starch. thus by several layers one within the other larger conductors and greater lengths and therefore greater mass may be used without lowering the resistance or increasing the radiating surface. The plastic carbon with lac may be mixed with powders regulated so as to allow of it being handled without breaking or a thread may be used the whole sealed with the plastic compound and rolled out the thread above the whole (even when the mass of carbon assumed it is weak) to be handled without fear of breaking. An iron wire might be used and thickly coated with the plastic material and carbonized the shrinkage would of course produce cracks but these could be filled up of plastic carbon and the whole spiral recarbonized, with platina contacts. Afterwards the iron wire could be taken out by acids. Even platina wire might be used. Spirals and different forms of burners may be obtained by carbonizing regulable fibre such as wood, cotton, etc. If a thread is formed to the platina wires by a little of the plastic carbon and the whole carbonized and subjected in a closed chamber to heat the thread and plastic material will be carbonized

and become a conductor. one half inch of thread will offer a resistance generally of 100 ohms, but of course the resistance will be variable as a whole and in different parts of its course and light is costly, hence it is better to increase the conductivity and length to enable one to obtain lamps having nearly the same resistance one inch of such composed of eight of the fine threads is well worth with the platina lamp blocks filled and secured to the platina conductor as heretofore described. But after carbonization is sufficient seems for practical use but has only a resistance of 20 ohms hence a greater length than one inch is necessary to attain 100 ohms and so to prevent a great increase in the radiating surface it must be coiled or otherwise arranged. The conductor of platina in an ordinary vacuum standard is consumed in a few minutes but if sealed in a glass bulb and the air exhausted by a Sprengel pump provided with a chemical drying tube filled with pitch, sulphuric acid, a phosphoric anhydride and a tube with finely divided copper for absorbing mercury vapor and the exhaustion carried to a point where the McLeod gauge shows the pressure to be at least $\frac{1}{500000}$ of an atmosphere the carbon may be brought up to a point where although giving a light of 3 gas jets is absolutely stable notwithstanding its fragile nature, paper may be substituted for the thread Vulcanized fibre which is paper wood and used. the contact with the platinum wires being made by the use of the plastic carbon. In fact any substance which will give a frame work of carbon when subjected to heat within a closed steel tube may be used. I am now engaged in perfecting methods for the rapid and economical manufacture of these conductors which will be the subject matter of patent applications.

U.S. Caveat and English Provisional Protection
Dec. 19 1879

In my system of Electric Lighting I have proposed in a previous patent to regulate the pressure or electro motive force at the central station by varying the strength of the field magnet around the induction bobbin connected to the main conductor thus rise or fall in the electro motive force due to putting on or off Lamps being indicated by an Electrometer. I find that an electrometer similar to that of Weber but of high resistance is an improvement upon the electrometer owing to its greater reliability. Two of such are used and connected across the main conductor in multiple arc.

In my system a city is divided up into districts in each district there is a central station which station is provided with sufficient motive power and electric generators to supply half a mile radius of this station I employ say five engines each of 250 horse power each belt runs by what a separate line of shafting on this shafting is billed say 40 electric generators so that each engine and its system of generators may be considered complete within itself. Large rods of copper are conveyed in proximity to all the generators and connecting levers are arranged so that any generator may be placed across and feed into the two main conductors. All the generators when connected to the mains are connected in multiple arc and the field magnet of any generator is so wound on the edge of the pulley upon its shaft made such a diameter that either by increase or decrease of speed or by a weakening or strengthening of the field magnet the electro motive force of the induction bobbin may be adjusted to name exactly the same electro motive-force as all the other machines. I employ several subsidiary electric generators fitted on the shaft of the first engine which are all in use and the current from these machines is conveyed by leading wire to the field magnets of all the generators and serve to keep a constant field. A second wire of these subsidiary machines is connected to the shaft of the second engine and connected in duplicate to be used in case of

emergency or in case where the first engine stops. A switch serving to change the subsidiary generator from one set to another so the change can be made gradually.
The subsidiary generators are also arranged in multiple arc but the field magnets of main line generators are so connected that there will be a set of say ten magnets connected in series and five set connected in multiple arc. whether arranged in series say ten field magnets are disconnected at once the induction bottles having previously been disconnected from the mains.
To energizing the field magnets of the subsidiary generators I use a Dynamo Electric Machine the current from which passes through the field magnets of all the subsidiary generators either in series or in multiple arc in the circuit I place a large number of resistance coils of large wire and subdivided so that each five say 50 of six ohms, a wire between each resistance coil leads to a rotary commutator which in turning short circuit a greater or lesser number of resistance coils thus increasing or decreasing the strength of the current in the field magnets of the subsidiary generators This in its turn increases or decreases the strength of the current in the induction bottles between them, and the current in its turn increases or decreases the strength of the field magnets of the main line generators and causes a rise or fall in the pressure or Electromotive force of the current according as more or less energy is drawn from the stations by putting on or off Lamps or electric Engines.
Thus I am enabled to cause a raise or fall in the pressure or Electro motive force by turning of the commutator handle.
To indicate the rise and fall of electromotive force the operator at the commutator has before him the Electrodynamometer as well as several standard Lamps to indicate the rise and fall.
This apparatus I propose to place in a room disconnected from the main Rooms containing the generator and engines commutator therewith being made by some but the movement of the commutator is transferred by gearing and shafts to a large dial placed one in the generator room and one in the Engine Room so that the station master may know the proper time to start

up or stop down one or more of the engines. It will probably happen in practice that from the breaking of belts or a wire or other cause that a generator will cease to pass electricity to the main although the induction bottom be intact this will cause the current from all other generators to cause their generators to reverse its motion and perhaps burn the wire, to prevent this I interpolate a short wire in the induction bottom current made of bismuth fusible metal which will melt and save the wire of the generator before too great a heat is reached. Between each generator I place a loose pulley on a stand upon an upright upon which the belt may be thrown in case a generator is to be stopped when the battery of generator of which it is one is in use
It is well known that at different parts of the main circuit outside of the generator electric Engines almost similar to the generator may be placed for the purpose of giving rot power to shafting. I find that Engines giving varying amounts of power from 20 horse to 20 of a horse may all be worked in multiple arc. The less the power required the smaller the machine and the greater length and a finer wire used than that for a larger power. And I find that it is preferable to place the greatest length of the wire and resistance upon the field magnet. In using these small machines in multiple arc for running a sewing machine I arrange a switch for disconnecting the machine from the circuit, a belt to connect the motor with the sewing machine using a very small pulley on the motor and a large pulley on the sewing machine so as to allow of high speed in the motor I regulate the speed of sewing by a friction lever pressing on the driving pulley of the sewing machine which lever being connected to the foot rest may be pressed lightly or heavily on the pulley of the sewing machine and thus increase or diminish its speed instantly or stop it all together. The pulley of the motor being a friction pulley allows the motor shaft to revolve at a slower speed even when the belt is stopped. When the motor is arranged to pump water to a tank I use a float which when the water becomes too low closes the current and connects the motor with the main line and when the water is sufficient another float serves to disconnect the motor from the circuit for running

machine shaft with these motor cords where an non spin is required I arrange upon the shaft of the motor a governor working in the ordinary manner but which when the speed has reached a certain point causes a lever to open the circuit and disconnect the motor from the circuit.
These motors work upon the same main conductor as the lamps

The object of this invention is to obtain light by the incandescence of electric conducting matter.

The invention consists in various methods of manufacturing the lamp

I have found that when paper is used that it should be specially manufactured so as to obtain pure carbonizable fibre without sizing and other foreign materials. Ordinary British board contains Rosin & other ingredients for making it non porous to ink this resin carbonizes as well as the fibre and being in some lots of paper in quantity or lesser quantity makes it very difficult to obtain incandescent conductor of the same degree of conductivity when subjected to the same carbonizing pressure. To obtain this I obtain paper free from sized matter and after cutting the pieces of paper to make the conductor in a larger form than the final cutting I soak these in a solution of sugar in alcohol or Alcohol & water or in a water solution of sugar. The strength of these solutions must be such that the required resistance is obtained if a low resistance is required a thick solution of sugar should be used and if a high resistance the strength of the solution must be diminished. The form shown in the form of burner which I have shown in an application has thickened ends which serve to make good contact with the clamps. I now cut out another piece or two pieces of a shape exactly like these thickened ends. I place one on each side moistening them slightly with a syrup solution of sugar this serves to hold them in their position and when carbonized the sugar carbonizes as well and these make a solid piece which allows of better clamping

I also have succeeded in plating these ends with copper, nickel, & other metals, which serve to make excellent contact between the clamps and the ends. I effect the deposit by hanging the loops upon a wire which is connected to one pole of a battery and allowing the ends of the loops to dip in the plating solution the proper distance, the jar containing the plating solution being in contact with the other pole of the battery. In using long fibre such as manilla hemp and other fibres of the hemp family I also plate the ends very thickly and afterwards drill holes in the metal deposited by electro deposition

tap the same end, set in a short length of platina wire. This wire is secured to the platina wire passing through the glass by a collar or clamp.

I make lamps consisting of several fibres each spread out but all coming to a common clamp but in this case the aggregate radiating surface of all the fibres do not exceed that of a single paper bamboo conductor. I also bunch all these fibres together & pass the aggregate filament through a solution of sugar to hold them together. A single end wire or an aggregation of distinct fibres I secure their ends to a piece of carbonate wire such as Lamine Wire, for wire occurant Black fibre by drilling a small hole in the wood & inserting the fibre through this hole and pulling a slight connection of sugar on the wood, the whole is carbonized and gives a good obstinate end for clamping a short piece of platina wire being placed in one end of the mould when the fibre is carbonized, the wood shrinking tends to clamp itself upon the platina under great force. In these clamps of carbon contain a large quantity of gas which some not very easily in the vacuum. It is fair to assume clamps of carbon which have been carbonized and subjected to high incandescence in vacuo to run it free air. Small pieces can then be used with fibres for wide a very small ~~carrying~~ quantity of sugar passing to hold the fibre & the clamp in the act of carbonization. Paper bamboo shows a burner made of fibre may be (after carbonization) placed in combination tube in platina wire and a hydrocarbon vapor passed through the tube by the aid of a Bunsen water vacuum pump. The hydrocarbon being decomposed a very hard carbon is deposited upon the shaped conductor. The most perfect fibre for carbonization and use for lighting by incandescence or for arc purposes, is a fibrous grass from South America called Monkey Back fibre, each blade of grass which are generally found is composed of a great number of fibres and the whole cemented together with a natural resin which serves to carbonize and lock all the other fibres together, making a nearly homogeneous filament. These blades of grass are of various size from 1/10 of an inch in diameter to 1/100 of an inch, they are slightly tapered. I

I make a cutting die through which I pull the fibre the sage of the die serve to shave off the outer matter of the thickness and another plane is to use a revolving cutter the cutter revolving and is passed along the fibre. These fibres when since may be put between paper ends which are sugared and then carbonized or a small platinum Iridium wire may have a hole drilled in the end about the size of the fibre after carbonization the wire is split to the bottom of the hole or borer, the fibre is placed in the hole and if the interior of the wire is made slightly taper a ring may be placed over it thus clamping the fibre very tightly

In carbonizing we mould we have sometimes dispensed with the tissue paper between each of the paper shoes or fibre shoes with the weight on top and instead made a small indent into a nickel plate having a depth a little greater than the thickness of the paper over this another nickel plate is placed of a paper shoe is placed in this mould and the top plate put on it lays in a very thin chamber, but is free to contract, the two plates are placed in the middle bar and then passed through the carbonizing process the shoe will, being free from restraint contract in a somewhat irregular shape but it will have less time and withstand a higher incandescence. As platina continue to a certain extent with heated carbon I let into the moles of my clamps the plate of Iridium which does not to the same extent combine with carbon gold chromium manganese chrome iron, silver and many other metals may be substituted for the Iridium but whether they will last for long periods of time I am now ascertaining.

I sometimes roughen the surface of my platina clamp so as to ensure better contact. I also instead of placing the tightening screw some distance from where the carbon is clamped, cut a hole in the thickened part of the shoe before carbonization and then place the shoe in the clamp and put the tightening screw through this hole. I have found a small spiral which forms a sort of a cup and secures one of these spirals to each of the platina wire which are sealed in the glass, in this cup. I free the round carbonized wooden ends of the fibres. In distributing both power and light & where there is a difference of price to be charged for electricity when used for light ~~and~~ power. I place a double meter in the house

This consists and consists of the leading wires of the light to one pulley and extra leading wires to the magnetic motor to another pulley. As the motors will to different purposes be required to run two or three, & vibrate each with a pressure which when the same increases above a certain rate force the circuit and disconnect the motor from the main wires, and as it falls in speed close the circuit again as it would be entirely impracticable to use an ordinary one point circuit breaker and strong magnetic governing to the great spark due to the extra current of the induction within the field magnet & use several points and springs so arranged that the circuit is broken simultaneously in several places and this is reduces it in any one single point as to practically obliterate it as far as any great destruction of the contact points are concerned

It is obvious that the power may be run on the main shaft of the motor or separately, motor being run it by gear wheels worms & wheels or belts connected to the main shaft

There is a defect in the slow carbonization of organic filaments as then Hydrocarbons are alternately evolved in carbon and are only decomposed by the highest incandescence and after a long period of time to obtain a more capital carbonization I take a large platinum iridium wire bend it in the form of a horse shoe, form a groove on this wire two or three times the size of the fibre which is to be laid in it after this is done I put in a piece of the platinum iridium which was to cover the slot in which the fibre is laid, the ends of the horse shoe are secured to circuit clamps & the whole arrangement is placed in vacuo the wire is slightly heated to drive off the water vapor then brought suddenly to incandescence to effect the carbonization carbon may be substituted for the platinum iridium, even viscous substances may be carbonized in these grooves, such as sugar must be melted in tissue paper to prevent it sticking to the platinum iridium.

Menlo Park

T. A. E.

The object of this invention is to transmit sonorous vibrations into electric waves for telephonic purposes.

The invention consists in the combination of various finely divided conductors with suitable mechanism that such translation may take place.

Fig 1 shows my present form of transmitter for translating the sonorous waves into electric waves.
A is the case, B a vulcanite cup in the bottom of which is a plate of metal C preferably of platinum but it may be of any metal. Over it a button of finely divided conducting matter, connection being made to the button by a metallic ring as in figure 2. Upon this rests a button of finely divided material which conducts electricity. On this button rests a plate of metal E or button of finely divided conducting material connection from which is made by the ribbon F. The base is connected to one wire and the top plate F. These are included in the circuit of the primary wire of an induction coil.
G is a plate which rests on contact with E and serves to condense upon it the sonorous waves. This plate is fastened to the case. This plate is not necessary when sonorousness of adjustment is more desirable than loudness for the sonorous waves may impinge directly upon the sensitive tension regulator itself as in fig 3. In this case B is the case, C is the bottom plate, D the button of finely divided material, E a plate with turned up edges to prevent spittle from coming in contact with D. F is a spring to hold the plate E in contact with D when in various positions. G is the mouth piece. The operation is exactly the same as the apparatus in fig 1 the sonorous wave striking the plate E produces a concussion and causes a greater number of points upon the button D to come in contact with E the number of course being proportionate to the strength of the sonorous wave. After long experiment I have ascertained

that the principle upon which the electric current is varied in strength by the action of sonorous or other vibrations acting upon finely divided conducting matter is due almost entirely to the greater or less number of contacts or points which come in contact with each other or with a metal plate. For instance in the case of a lamp-black button 3/4 of an inch in diameter I have calculated by comparison under a microscope with a Rutherford grading that there are not less than ten million particles of Carbon on each side, hence if the button is included in a current between two metal plates with a certain initial pressure four million particles will be in contact with the plate, and these points will offer a certain resistance. If now the pressure on the button is gradually increased 5, 6, 8, 10 millions of particles additional will be brought in contact thus reducing the resistance owing to the almost infinite size of these points the internal contacts making so infinitesimal a rise and fall of tension by themselves the sounding magnet is unable to follow them and they are not heard and it only responds to the rise and fall of tension taken as a whole. In the case of a less finely divided substance the particles may be so few in number and the button so insensitive that these internal contacts are heard as well as the main waves. In this case the speech received is harsh and disagreeable. It follows that any substance which is a conductor may be finely divided either by chemical or mechanical means and placed in suitable forms (either with or without non-conducting substances to give the required elasticity). It follows from what I have above stated that lamp-black Carbon is preferable to any other substance owing to the fact that of all conducting substances which I have so far tested it seems to be the most finely divided, hence it gives a fine wave and it also gives the greatest variation in the strength of the current by a given wave than any other substance. It is not oxidized at common temperature and does not absorb moisture. Carbon in the form of Charcoal, Coal soot, graphite,

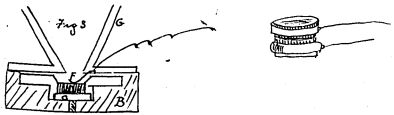
Carburet of iron, gas retort carbon, all have larger particles. Iodide of Copper, Peroxide of lead, and black oxide manganese seem to be the best. Of the finely divided metals those which do not oxidize are preferable such as gold, nickel, ruthinium, osmium, iridium, palladium.

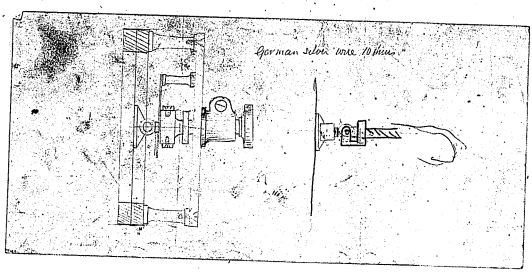
Many of the oxides give very good results such as protoxide of Copper and iron, also many sulphides, such as sulphide of lead, copper, iron, nickel. Even a metal such as platinum rolled like a diffraction grating used in spectrum analysis, but in both directions at right angles, gives an enormous number of points and produces fine results, especially when the metal is thin and elastic. I do not wish to confine myself to any substance to be used, neither do I desire to confine myself to any particular device for holding the finely divided substance or to any particular form of substance or limit myself to one piece, as such finely divided substance may be mounted in innumerable forms, and includes in and may be form part of a circuit in many ways and diaphragms, tables, resonant boxes, or the substance itself may receive the sonorous vibration, several pieces may be mounted in one circuit resting one upon the other.

I claim – The use of pieces of finely divided conducting matter forming part of an Electric circuit for transitting sonorous waves into Electric waves for telephonic transmission.

2d The transmitter constructed and operated substantially as described.

Fig 1 is the model





[ITEM FOUND IN BOOK]